VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL AIR CONDITIONING, REFRIGERATION, AIR SANITATION, PIPING, HEATING AND VENTILATION

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MEMBER
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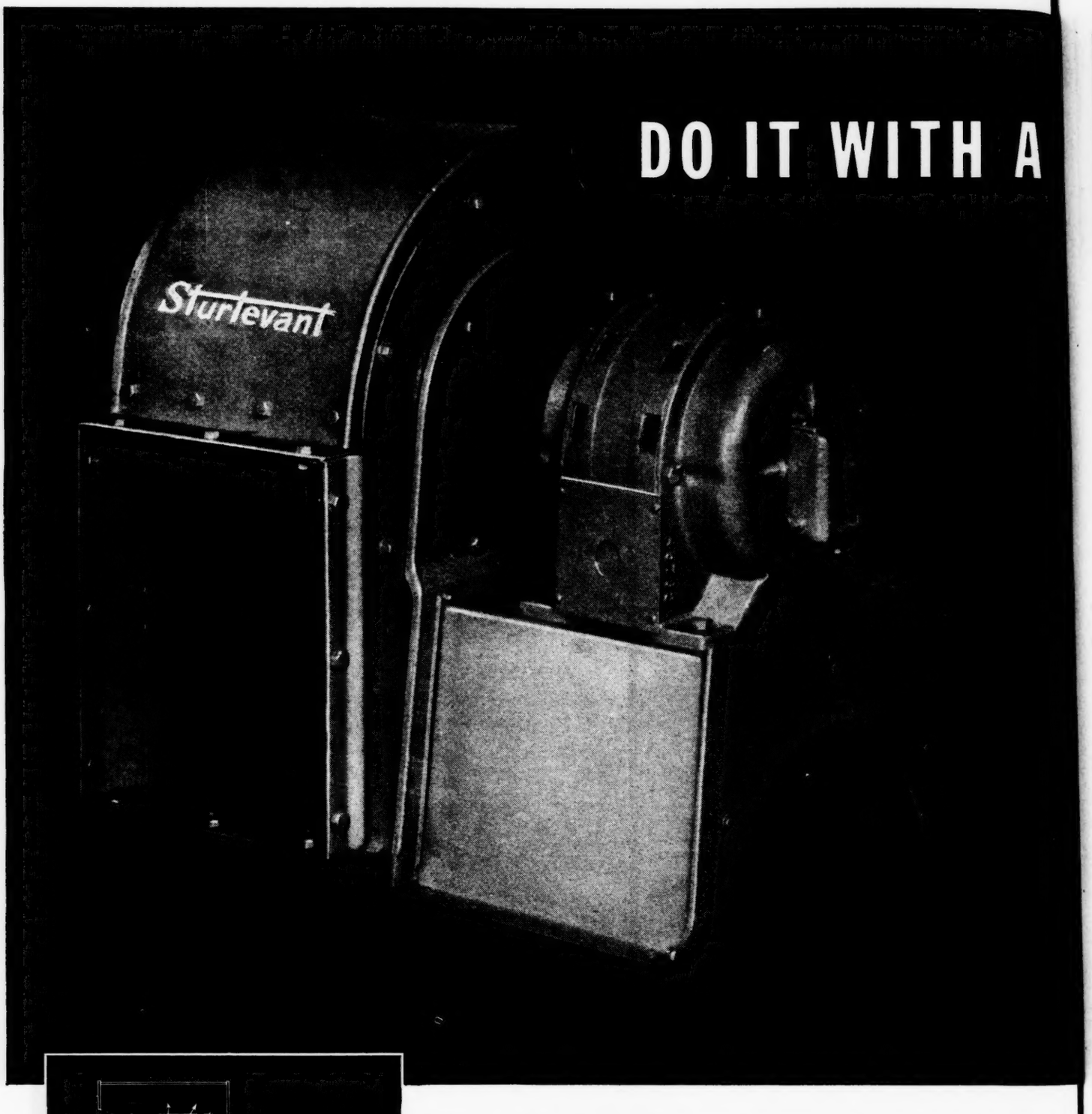
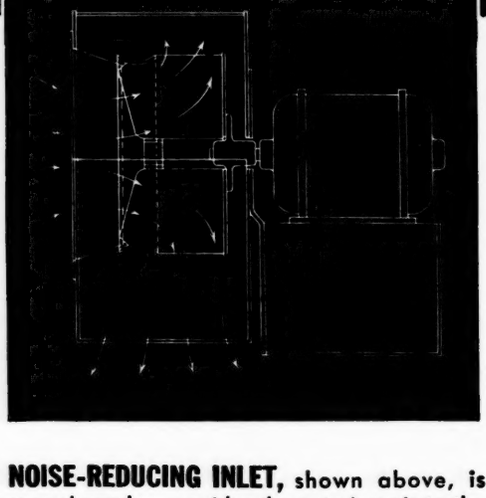
THIS MONTH'S COVER

Picturesque sky shot atop new Maxwell House plant on Hoboken waterfront shows roof ventilators. Photo by Schnall.

DO IT WITH A





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Washington News

LORING F. OVERMAN

CPA is optimistic.
Next June may see 200% production.
Recession ended?
Commercial construction up.
Pipe lines adrift.

WASHINGTON'S November item of perhaps the greatest interest to the heating, ventilating and air-conditioning industries was the Civilian Production Administration's Report on Reconversion, which forecast that by next June reconverted metal-working industries will be producing at an annual rate nearly 2½ times their total 1939 production.

The forecast, a digest of returns submitted by manufacturers themselves, also indicates that employment is expected to reach 5 million by mid-year, compared with 2½ million in 1939. CPA issues the report with the observation that estimates of future production and employment are based upon the assumption there will be a measure of industrial peace permitting steady production in the months between now and June.

Some who have read the CPA report have their doubts it will contribute to industrial peace, for in manufacturer-submitted figures it appears to bear out labor's contention that output per worker will be increased to such an extent under postwar methods that requested wage boosts could be readily absorbed.

Report Encouraging, If—

By accepting the possibility that labor disturbances will be spotty rather than general, and that they will be settled in short order in any event, the CPA report offers two reasons for study by the heating, ventilating and air-conditioning industry.

First, of immediate interest is the anticipated progress of the producers of components needed in fabricating and installing refrigeration and air-conditioning equipment.

Second, the progress of other industries will serve as a guide to the probable buyers of refrigeration and air-conditioning. In this latter group, two possible outlets should be noted. One is the converted manufacturer himself, possibly with plans for expansion and improvement. The other is the manufacturer's customer—the receiver of equipment that signals his probable further need for the products and services of the heating, ventilating and air conditioning industries.

The following industries, digested from 55 covered by the report, are considered of possible interest to readers of this column:

Refrigerator Industry

Eighteen firms reported, representing 69 percent of the industry, including important amounts of commercial and industrial refrigeration. By next June the monthly value of civilian production will be almost 40 percent greater than the peak war production rate, and about four times the 1939 rate. By June, employment is expected to increase more than 75 percent, to two and one-half times what it was in 1939, and one-third higher than the wartime level.

Plumbing and Heating Equipment

Value of shipments next June is expected to be at 207.4 percent of the same month in 1939, with total employment at 153.6 of the 1939 figure. Reports from 32 reporting plants indicate that the months ahead will see a steady rise in shipments of pre-war products. The June figure is expected to be within 30 percent of the wartime level. If these forecasts are realized industrywide, next year's requirements for the products of this industry for residential housing should be met. Improvement in the foundry situation, still reported as critical, will be essential to these goals.

Manufacturers of electrical measuring instruments expect to be 212.7 percent ahead of June 1939 by mid-year 1946, with employment up to 188.7 of 1939.

June production of mechanical stokers was forecast as 263.7 percent of 1939, with total employment up to 186.1.

Pumping Equipment, air compressors—up 277.7 over 1939 by June; employment up to 195.1.

Measuring Instruments, mechanical—up 209.8 by June; employment up to 164.8.

User Groups of Interest

Among the recipients of reconversion products will be countless industrial and commercial buyers who will make up tomorrow's market for air conditioning and refrigeration equipment. High on the list in percentages of upped deliveries will be the car and car equipment industry, producers of railroad and street-cars. A very gradual rise is forecast by the reporting firms, but with the startling figure of six times 1939 levels as the anticipated output by June. Employment is figured at two and one-half times the 1939 level.

The automotive industry, if considered as a customer for air-conditioning of showrooms, may also prove of interest. The forecasts submitted, strike conditions overlooked, contemplate full employment by the middle of next year, with dollar value of output at three times the monthly rate in 1939. The pattern for each of the big three corporations is similar. However, the smaller passenger car makers forecast more extensive production increases which, with one exception, call for June shipments above the wartime rate of total production, and from four to nine times the 1939 dollar shipments rate.

Indicating that stores and offices may be regarded

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Pictured at right is one of Wagner's branch motor repair shops in operation —this one at the Detroit Service Branch.

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TACHOGRAPH
(Recording Speedometer)
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TRANSFORMERS

M45-22

Wagner Electric Corporation

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In Canada: Wagner Electric at Leaside, Ontario
ELECTRICAL AND AUTOMOTIVE PRODUCTS

as highly logical customers for air-conditioning equipment is the report of the producers of office and store machines. Reports from 15 plants, representing almost three-fourths of the industry, indicate that by June, 1946, production will be double that of 1939 monthly figures.

The hardware industry, important because its products enter into construction projects involving refrigeration and air-conditioning equipment, anticipates a somewhat slow advance. Shipments of builders hardware were at about the same level in September as in the first quarter of 1945, when the industry was producing approximately 60 percent civilian and 40 percent special military items. By June of 1946, the industry is expected to exceed the wartime level and be about one-fourth ahead of 1939 monthly figures.

In the food products machinery field, a June delivery 350 percent greater than the 1939 monthly figure is anticipated. This is food for thought by those in a position to serve the producers or users of this type of equipment.

Recession Ended

Sharing importance with the individual figures on anticipated increases over 1939 is the fact that the poll indicates an end of the recession due to war contract cancellations, except in three industries—aviation, shipbuilding and ordnance. Actual September shipments for all reconversion industries, other than those making planes, ships and guns, was 39% of monthly averages during the first quarter of 1945. Estimated October production was 42.3 percent, while the forecasts for December and June were 59.4 and 78.6 percent, respectively.

A higher level of production and shipment of reconversion items is now in prospect, and the gradual return of these strangers should prove a welcome addition to merchandising channels.

Commercial Construction Up

Percentagewise, commercial construction was in the spotlight during October, with 57 million dollars worth of privately financed work put in place during the month, the United States Department of Labor reports. The total was slightly more than four times the volume expended for commercial construction in October of last year, and is greater than the level for any October during the period for which monthly data are available (January 1939 to date).

While construction work on commercial structures showed a greater proportional gain than any other type of privately financed non-residential building, industrial building increased most in dollar volume—rising from $34 million in October 1944 to $111 million in October of this year. Other types of non-residential construction (educational, hospital, and institutional buildings) rose from 16 million to 38 million dollars.

Total privately financed work was reported at $426 million—almost double that of October 1944, and 6 percent above September 1945. Construction work financed from public funds, estimated at $134 million, was $10 million under the volume from September and $59 million less than in October 1944.

Although private residential (nonfarm) construction practically doubled during the year, it has not regained the dominant position it normally occupies in the privately financed portion of the construction industry. In October of both 1945 and 1944, it amounted to approximately one-fourth of all private construction expenditures. In earlier periods of prosperity residential construction has amounted to as much as half of all privately financed building.

Lumber Bottleneck Attacked

Accepting the shortage of lumber as one of the major deterrents to all privately financed building programs, the Civilian Production Administration on November 20 extended special priorities assistance to producers of lumber and logs. The assistance is provided through issuance of Directive 5 to Priorities Regulation 28, classifying lumber as a critical product and pointing out that supplies are "substantially less than present and anticipated requirements, and this shortage is so serious as to threaten the required expansion in construction. This represents a serious threat to the economy of the country during the reconversion period."

The direction entitles CPA field offices to give lumber and log producers CC ratings to replace machinery and equipment in imminent danger of breakdown, or to obtain construction materials and new capital equipment that will result in a substantial increase in production, except in areas where existing facilities are sufficient to handle available timber.

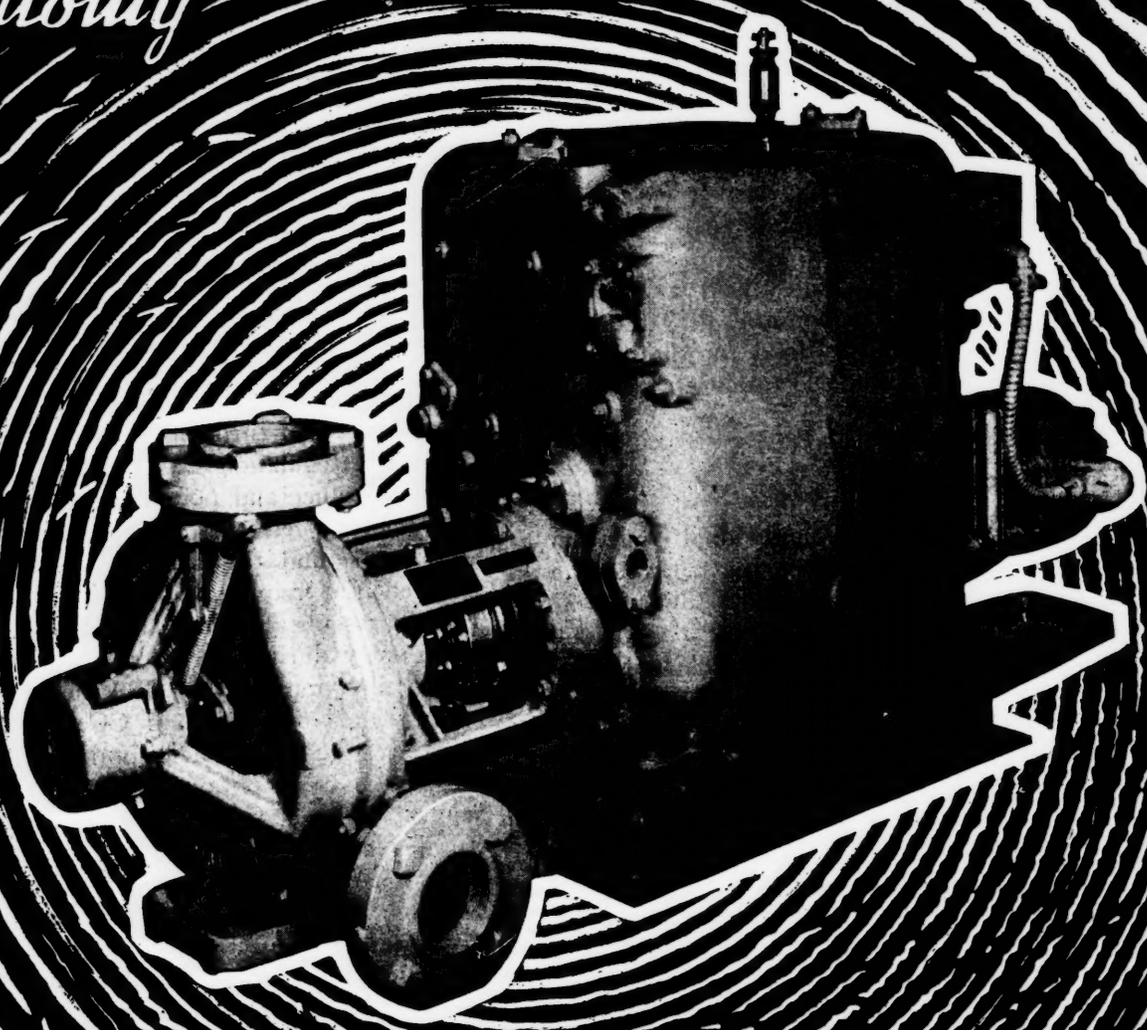
Assistance ordinarily is not given under Priorities Regulation 28 to replace machinery or equipment unless it has actually broken down. However, to avoid interruption of production of critically needed materials, special programs are set up under which CC ratings may be given under less stringent conditions.

Other construction materials which have been given similar assistance are clay building products and cast iron soil pipe.

Pipe Lines Cast Adrift

Another step has been taken in bringing to some sort of a conclusion—whether sale or abandonment is not yet known—of the Big Inch and Little Big Inch pipe lines which delivered millions of barrels of military and civilian petroleum products to the eastern seaboard during the war. The Petroleum Administrator for War revoked on November 14 Petroleum Directives 75 and 63, which enabled PAW to call upon oil companies to provide an adequate supply of oil and products for the lines. With the revocation of the directives, companies which supplied the pipelines are free to move their oil as they see fit, in accordance with normal peacetime practices.

Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

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More important, this pump insures absolutely uniform circulation in system. That means continuous steam economy.

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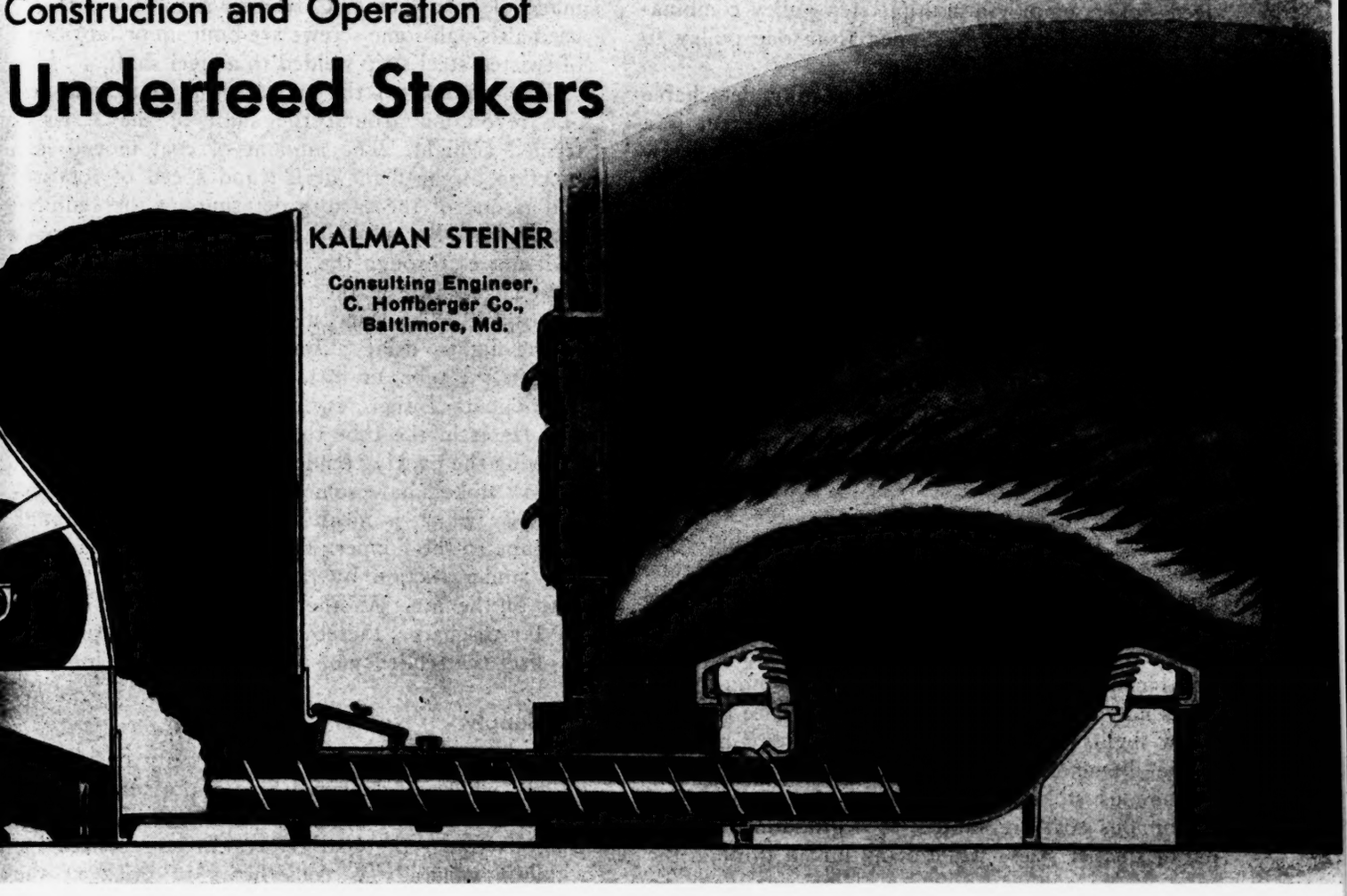
Construction and Operation of
Underfeed Stokers

KALMAN STEINER
Consulting Engineer,
C. Hoffberger Co.,
Baltimore, Md.



Longitudinal section through Link-Belt stoker and fuel bed.

Coal stokers may be classified as either domestic or commercial, as either overfeed or underfeed, as anthracite burning or bituminous coal burning. Of the commercial, underfeed, bituminous coal burning stokers, a further classification is made between single retort and multiple retort. It is to the single retort, underfeed, bituminous coal stoker in commercial sizes that this article is devoted, since that stoker type represents the largest portion of commercial stoker production.

AS its name implies, the underfeed stoker feeds green coal into a firebed from the underside, in contrast to handfiring or overfeed stokers, where the coal is fed to the top of or alongside the firebed. The temperature of the green coal is raised gradually as the coal approaches the combustion retort, permitting gradual distillation of the volatile combustibles. The volatilized gases ascend through a zone of incandescent coke where the oxygen supply is maintained by air under pressure issuing from ports at and near the top of the retort. Thus it is possible to secure substantially smokeless combustion with high volatile coals. The residue of mineral matter is fused into a clinker and either accumulates around the fuel bed until removed through the firing doors of the boiler front, or is dumped into the ash pit by means of tilting plates set along both sides of the firebox. The component elements of an underfeed stoker are: coal hopper (or bin), power unit comprising motor and transmission, coal tube and screw or ram, fan wheel and air duct, retort and windbox, hearth.

Transmissions

Commercial coal stokers are generally powered by electric motors running at 1750 rpm on 60 cycle ac or on dc. This power unit must transmit to the coal screw, which runs at very low speed, in the range of ½ to 6 rpm, the force that moves the coal through the coal tube. The mechanical advantage gained in the speed reduction gives the screw the force required to crush large pieces of coal, foreign material if not too massive, and otherwise keep the coal moving up to the retort as required. Some transmissions utilize conventional gear trains, others use planetary gear systems, and still a third class is hydraulic. It is usual to have a speed change arrangement that will permit two, three or four rates of fuel delivery. When ram feed is used, the transmission may be hydraulic, mechanical or steam piston. The ram speed in hydraulic and steam drive may be controlled to any value between minimum and maximum and so afford more flexibility of control. Screw feeds have been well adapted to operating needs and are used by most stoker manufacturers for units up to 1200 lb of coal per hr. Some screw

feed stokers employ a multiple step pulley combination, whereby a belt is slipped from one pulley to another to change screw speed.

The coal feed screw must be readily detachable from the power unit. The usual arrangement is a socket on the end of the shaft, into which the screw engages by means of a plug formed on the end of the screw shaft. Generally, the thrust on this connection is toward the front.

It is general practice to reduce from motor speed to feed screw speed in two stages if a gear train is used. The first reduction often is through a worm and worm gear. The second speed reduction can then be either through a set of spur gears, or a combination of ratchet and pawl.

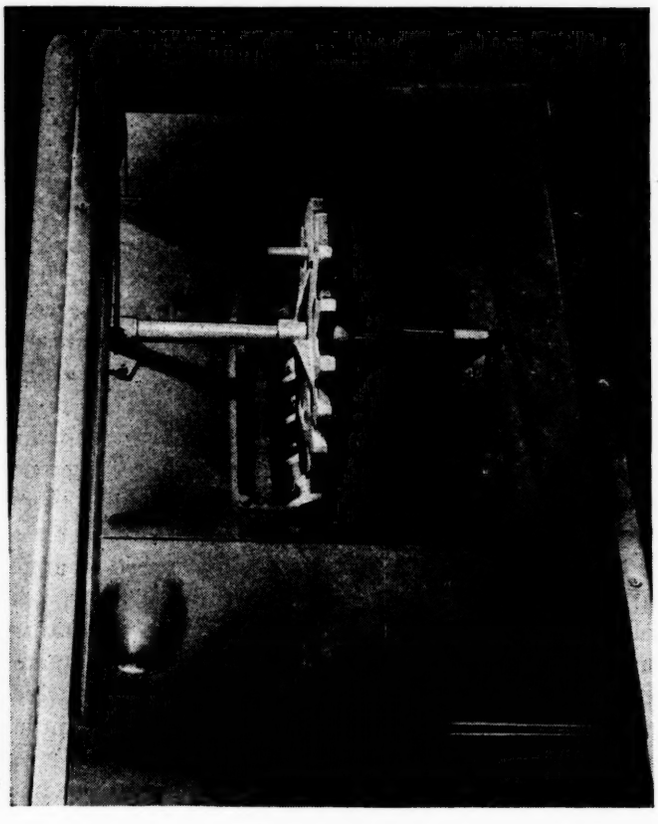
Coal Feed

Coal is transferred from the hopper or bin by a combination of coal tube and screw, or of coal tube and piston or ram. The tube is generally steel or cast iron, but sometimes of corrosion resisting steel alloy or non-ferrous metal. With domestic sizes of anthracite, brass tubes are not uncommon. Steel tubes may be drawn or cast. The clearance between screw flights (the periphery of the screw) and the inside diameter of the tubing is quite small with bituminous stokers—about ⅛ in. Some grades of bituminous coal are subject to degradation (breaking of smaller sizes) while being forced through the tube, with resulting formation of fine particles. To assist in keeping the coal fines moving, the clearance between screw and tube must be quite small.

The duty of the coal screw requires that it be made of hard metal. Cast steel is most commonly used although some screws are built up or fabricated of twisted steel strip welded to a steel shaft.

That amount of the spiral required to complete one revolution around the shaft of the screw is termed a flight. The amount of coal moved is a function of the flight design and speed of rotation, and is one of the factors determining the required motor size. Because bituminous coal tends to pack as it moves through the coal tube, the screw design must incorporate features to prevent packing, so far as possible. The usual method is to vary the pitch of the flights, using a smaller pitch in the hopper than in the tube, or to taper the exposed flights in the hopper. Either way will result in moving the coal faster in the tube than in the hopper, thereby relieving the packing tendency.

Most stokers have some means of preventing blowback, by which is meant passage of gases through the tube to the hopper. One method is to place the tube under suction by taking a connection to the inlet of the fan. Another is to introduce air from the fan discharge, thereby creating a slight pressure to offset the tendency of the gases to move forward.

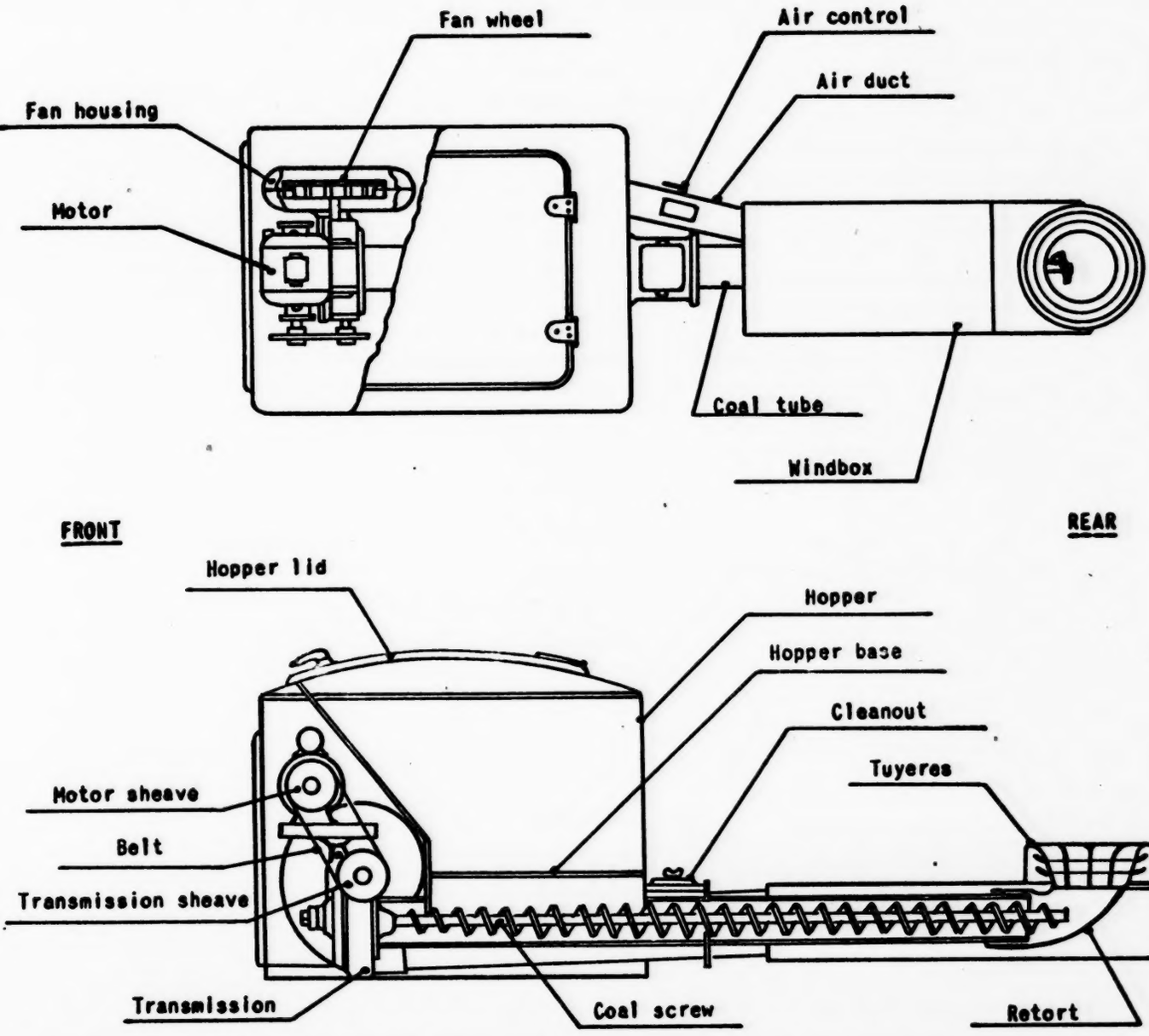


View of Iron Fireman hopper with agitators.

Air Supply

Underfeed stokers operate with only one source of air, which is delivered under pressure from a blower. This air is brought through ducts to a windbox under the coal retort. In larger sizes the windbox generally is constructed of brick at the time the stoker is installed. It is essential that the entire air-delivery system be air tight. There being no secondary air supply, by natural draft or otherwise, if the full capacity of the fan is not made available to the fire but is dissipated through leaks, the stoker will be unable to maintain its full rated output.

Stoker fans are either of the multiblade, forward curved type, with shallow blades, or of the multiblade, radial blade type, with full radius from periphery to fan center. The former, or so-called squirrel cage wheel, predominates. The pressure which the fan will be called upon to develop will depend upon the resistance to passage of the air from the fan outlet to the firebox. From the firebox to the stack, resistance of the boiler flues and the smoke pipe or breeching to the passage of the flue gases will be overcome by the natural draft created by the chimney. The major resistance in the passageway of air from fan to firebox is the fuel bed, the other resistances being the air duct and the air ports, which are known as tuyeres. The only variable in this series is the fuel bed resistance, and since the fan must be designed to meet the most severe condition of fuel bed resistance, which would occur at peak firing rate with a readily coking coal, the air flow must be controllable to lower requirements should the fuel bed resistance be lower than maximum. Particularly, there should be means of automatically checking the air flow should there occur a sudden drop in resistance caused by cracking of the fuel bed. Various stoker manufacturers



Standard nomenclature of underfeed stoker parts as established by the Stoker Manufacturers Association.

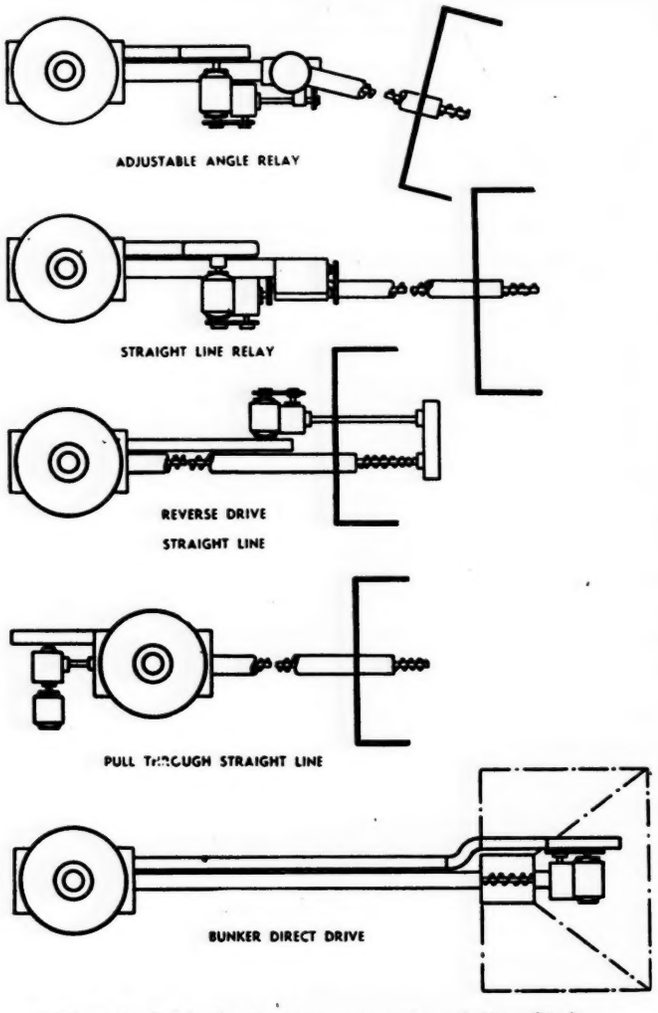
have worked out solutions in various ways, by incorporating devices into the air delivery system which, upon either abrupt or abnormal increase in air velocity or drop in air pressure, will act in some manner to restrict the flow of air to the retort.

When the air supply is controlled at the fan inlet, various styles of inlet dampers are used: discs which may be moved toward or away from the inlet opening, louver strips mounted horizontally, louver blades mounted vertically, etc. Stokers designed for having the rate of fuel feed changed manually may also have the inlet damper similarly arranged, but if the stoker is equipped with automatic feed control, as is readily accomplished with ram-type stokers, then the fan damper must be arranged for modulation with the fuel feed. Generally, too, it will be necessary to alter the setting of the uptake damper or equivalent, so as to provide the needed simultaneous change in draft.

Air is conducted from the fan outlet to the windbox by the air duct. Most air ducts are rectangular, and fit into similarly shaped openings in the fan housing and the windbox. The assembly of duct into the corresponding openings of fan and windbox must be airtight, usually accomplished by inserting gaskets. Gaskets are also used at joints in the air duct. The automatic air check, designed to hold down the rate of air flow to normal in the event of a crack in the fuel bed, is usually located in the air duct.

Retorts

That part of the underfeed stoker that supports the fuel bed is called the retort. Various shapes and sizes are used, but for bituminous stokers a popular shape is rectangular with the ends rounded at a radius equal to half the retort width. The tuyeres permit passage of air from the windbox into and over the fuel bed. Most retorts are assembled of small castings, shaped so that the assembly forms the air ports or tuyeres as well as the retort interior. The small castings are formed with fins on the windbox side, intended to dissipate heat when the stoker is not running but is carrying a banked fire. There must be sufficient space between the retort and the firebox walls for storage of clinker. In smaller sizes



Standard bin-feed arrangements of the Stoker Manufacturers Association.

the hearth is formed of refractory material that fills the space between retort and walls; in larger sizes it is necessary to set metal plates, called deadplates, along the firebox walls for clinker storage between the intervals when clinker is pulled from the firebox. Industrial stokers are sometimes equipped with side clinker dumping grates.

Coal is forced into the retort by the screw or ram. The retort bottom at the rear has an upward curvature. The combined effect of the pushing of the coal and the upward sweep of the bottom serves to distribute the fuel fairly well for moderate lengths of retort. As the retort attains considerable length, in the larger sizes of stoker, the problem of coal distribution in the retort becomes more acute. In ram type stokers, fuel distribution is assisted by the use of auxiliary pushers in the bottom of long retorts. Some screw feed stokers have a short reverse flight screw at the extreme end of the screw shaft, to break up packed accumulations of fuel. There has been some application of agitators in bituminous stoker retorts, but this use has been more or less confined to domestic sizes and is intended to break up coke trees which rise from the retort when an especially strongly coking fuel is burned.

Coal Handling

Underfeed stokers were first designed for hopper feed. Smallest sizes were equipped with hoppers holding 300 to 400 lb of coal, larger sizes having proportionately larger hoppers. Hoppers are made of sheet steel, in various shapes, but all are intended to accomplish two objectives: non-packing or non-clogging gravity motion of the fuel downward to the coal screw, and segregation of metallic and other foreign materials to a point where removal can conveniently be made through the cleanout trap. For most coal, a slope of 45° minimum is required to maintain free motion of the coal. Some hoppers are equipped with agitators to break up packed coal masses.

Increased consumer demand for freedom from manual coal handling led to development of bin-feed arrangements. Numerous conveyor systems are in use, of which some standardized forms are illustrated by the Stoker Manufacturers' Association in its Technical Manual, reproduced here in Fig. 2. Aside from the fundamental purpose of permitting fuel feed as required by the boiler load, the fuel handling must incorporate provision for avoiding degradation of coal size (breakage), and preventing coal packing in masses that obstruct movement toward the retort. Some systems that are quite satisfactory on anthracite will not give satisfaction with bituminous coal because of the greater packing tendency of the latter.

Details of Construction

Underfeed stokers must withstand the action of several deleterious factors: corrosion, attrition, heat, expansion and contraction, chemical fluxing. All coal contains some moisture, which of itself promotes corrosion. To the action of water is added the effect of sulfurous gases and calcium chloride (the latter sometimes is used for dustless treatment of coal). As rapidly as a steel or iron surface rusts, the abrasive action of the coal brushes away the oxide and presents a fresh surface to the corroding agents. The normal corrosive rates at ordinary temperatures are vastly magnified at elevated temperature.

Coal hoppers are generally fabricated of sheet steel, No. 18 gauge being commonly used for smaller sizes, heavier gauge for larger sizes. Retort and tuyere segments are generally cast in gray iron, and some tendency is observed toward the use of alloy steel castings for this service.

Underfeed stokers require some form of protection against damage should foreign material work its way into the coal tube and jam the mechanism, or should packing of coal in the tube cause jamming. The commonest protective device is the shear pin, which is a pin or key made of soft metal that will break when the mechanism becomes overloaded, freeing the transmission from the coal screw. Other protective arrangements include throw-out clutches incorporated into the transmission, and relief valves on hydraulic systems.

An alarm feature may be included, to sound a warning when the protective device interrupts stoker operation.

Classification of Sizes

Underfeed stokers are classified into groups according to maximum hourly coal burning capacity in pounds, as follows:

Class 1	Up to 60 lb per hr
Class 2	61 to 100 lb
Class 3	101 to 300 lb
Class 4	301 to 1200 lb
Class 5	over 1200 lb

Class 1 stokers are primarily used for domestic heating plants, and include some 70% of all stoker production. Class 2 stokers are usually installed for the heating of small apartments and large residences. Class 3 applications are larger apartments and small commercial buildings. Classes 1 through 3 stokers are mostly of unit construction, with air ducts and windboxes usually part of the stoker assembly and independent of the setting. Class 4 and 5 stokers are the commercial and industrial sizes; details of mechanical design vary widely and may include steam and hydraulic ram feeds, ratchet type and continuous gear train speed reducers. Class 4 and 5 stokers vary more widely between themselves as to design and construction than stokers in classes 1 through 3.

Table 1 gives suggested minimum and maximum combustion rates for commercial and industrial sizes of underfeed stokers.

TABLE 1.—SUGGESTED MAXIMUM AND MINIMUM COMBUSTION RATES FOR STOKERS

(From Guthrie, "Small Underfeed Single-Retort Stokers," ASME, 1937)

Stoker capacity, lb per hr	100	150	250	350	500	700	900	1200
Minimum grate area, sq ft	4.0	4.8	6.5	7.9	11	16.3	18.3	21.2
Maximum combustion rate, lb per sq ft at grate per hr	25	31	38	44	45	48	50	56
Maximum grate area, sq ft	9.0	15.0	16.0	18.4	22.9	30.5	33.0	33.0
Minimum combustion rate, lb per sq ft at grate per hr	11	15.0	16.0	19.0	22.0	27.0	27.0	36.0

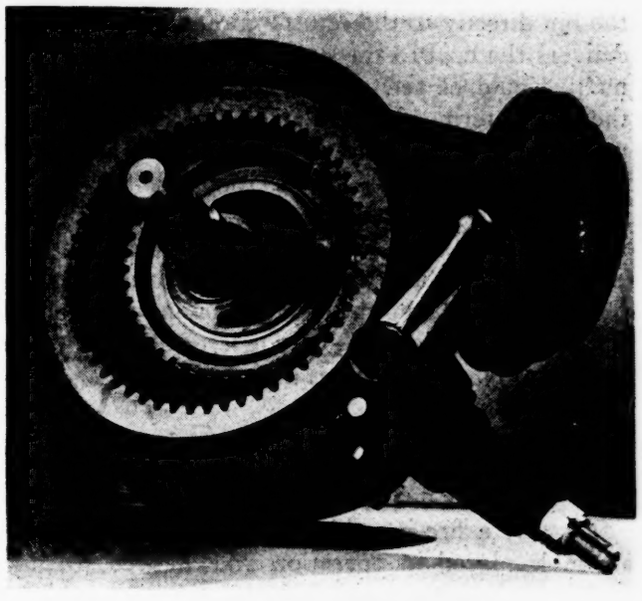
The SMA Technical Manual previously cited gives explicit directions and data for the selection of a stoker size for any given load condition, and for the firebox volume, setting heights and other installation details. Recommendations of SMA are based on a heat release rate of 60,000 Btu per cu ft per hr. Many municipalities have ordinances regulating furnace design which establish a lower rate of heat release in stoker installations.

Installing the Stoker

The firebox of the boiler must be cleared of grates or any other equipment that might be present. If the available combustion volume will be adequate, either on the basis of SMA recommendation or local ordinance, whichever requires the greater volume, then the hearth construction may proceed without further preparation. However, should additional combustion volume be required, this can be accomplished either by raising the boiler or by digging a pit. In setting new boilers, the higher setting is usually simpler, but existing boiler settings will generally have to be pitted. This pit must be carried back under the stoker setting to the bridge wall or rear of the hearth, and must be carried forward sufficiently to permit placing the stoker on the same level. It is necessary also to verify that there is sufficient clearance to allow the coal screw to be withdrawn from the coal tube.

In square or round fireboxes the retort is usually centered in the firebox. In rectangular fireboxes the retort is also centered if the distance from the front edge of retort to front (hopper end) of firebox does not exceed the maximum stipulated by the stoker manufacturer. In long fireboxes, where the retort if centered would be too far back, the retort is set at the maximum distance allowed from the front, and a bridge wall is constructed to form the rear firebox wall at about as far to the rear of the retort as there is clearance between retort and front wall.

For smaller stoker sizes, the retort end is supported at the right level by bricks placed under the windbox. Cork is useful in noise reduction when placed under the supports at the hopper end. The ashpit or other opening into the firebox through which the stoker is inserted is closed by means of common brick and mortar, the front face being smoothed off with asbestos cement. The space between the retort and the firebox walls is then filled in, to a level about 3 in. below the hearth line on the retort, with pea gravel or crushed stone. A layer of plastic refractory is then pounded into place to bring the level up from the top of the gravel or stone to the hearth line. The plastic must be applied evenly, tamped down with a 2-lb hammer having a surface of about 4 sq in. The plastic should seal all openings, and leave no cracks or crevices around the water leg of the boiler or wall of the furnace. An alternative method is to use castable refractory, mixed to a consistency recommended by



Planetary gear transmission of a Winkler (U. S. Machine Corp.) stoker.

its manufacturer, and poured to the equivalent depth over the gravel foundation. The cast hearth should be allowed about 12 hr to harden, before fire is started. A plastic hearth, however, may be fired immediately after construction. A good precaution is to burn a wood fire for several hours gradually to dry the plastic before the coal fire is started.

Larger stokers necessitate that the windbox be formed of brick at the time of installation. The four walls of the windbox are built up of common brick to within a few inches of the hearth, and the deadplates rest on these walls. Above the deadplates the firebox walls are refractory and extend to a level a few inches above the bottom of the water leg. In those cases where pitting has not been necessary, there may not be firebrick walls above the deadplates, the top of the retort being at approximately grate level. In all cases, the area between the edges of the deadplates and the firebrick walls or water leg is filled with plastic refractory.

Where it has been necessary to dig a fairly deep pit for the stoker, the hearth may be so far below the floor line that pulling of clinker through the fire door may be difficult. In such cases it is usually advisable to provide a steel plate across the entire ashpit front, with special doors attached to permit clinker pulling with minimum interference. Where the deadplate level is less than 2 inches above the bottom of the water leg, refractory protection of the water leg should be provided on stokers larger than 100 lb per hr.

Bin Feed Arrangements

Since one of the chief advantages of the coal stoker is reduction of labor and furnace attendance, many designs of bin feed stoker have been developed. The height to which coal is piled in a bin does not materially affect the load on the transmission or screw. The screw and surrounding tube are similar to the feeding means between hopper and retort. For bin feed, the screw can be quite long. In some styles of bin feed, a single screw conveys coal from the bin directly to the retort; in others the bin screw delivers the coal to the point where the hopper normally would be set, and a transfer is accomplished, the coal entering the regular feed screw and passing up to the retort in the standard arrangement. The Stoker Manufacturers Association has set up five standard bin feed arrangements, illustrated on page 76. The bin itself is designed to fit the accommodations of the particular installation, the principal points to be observed being the need for having the coal converge upon the screw at an angle of about 45°, and the desirability of lining the wood structure with light sheet metal.

Starting the Fire

To start a fire in a bituminous stoker, the mechanism is placed in operation and allowed to move coal into the retort until it is quite full, there being a sizable mound of coal, in fact, above the retort and tuyeres. With paper and wood a fire is kindled above the coal in the retort, the wood being allowed to attain a brisk rate of combustion. The stoker is then placed in operation. Air from the fan will cause the fuel bed to build up an incandescent temperature quickly. The rate of fuel feed must then be adjusted to the load.

Generally speaking, a stoker fuel bed should not be disturbed except for removal of clinker. Since in normal operation the clinker of a bituminous stoker fire accumulates between the tuyeres and the furnace walls, its removal should not affect the fuel bed structure materially. It is not recommended that the fire be probed for location of additional clinker or for breaking up coke trees. Experience and observation will reveal how often clinker should be removed. A safe rule to use is that the clinker removal cycle should be as long as possible, that is, the clinker should be removed periodically but the interval between removals should be as long as conditions permit. This will be governed by the firing rate, load, percentage ash in the fuel, and clinker storage space on the hearth. Summer operation at light loads, as when heating service hot water only, will not produce fuel bed temperatures that exist during heavy winter firing; it may be necessary to use during the summer a coal with a lower fusing ash.

Setting of air supply is best done with the aid of instruments: draft gauge, orsat, and stack thermometer. The readings of the orsat should be interpreted with caution. Carbon dioxide content in the flue gas is constantly changing. An average analysis, to be truly representative of actual conditions, should be composed of grab samples taken over a half-hour period. An intense white fuel bed usually indicates too much air. A lazy, smoky fire probably needs more air. A well adjusted air-fuel ratio should result in a fuel bed with a clear, yellow, billowy flame, free of smoke. If the fire burns low in the retort, the fuel is being burned too rapidly or is not being fed fast enough. The fuel feed rate should be increased; if that does not remedy the trouble, the air supply should be reduced. Conversely, if unburned coke accumulates in and fills the firebox, the combustion rate is too low, and should be corrected by admitting more air or less fuel, or both. Sometimes the holdfire period, which is automatically timed by the control relay, is not sufficiently long to permit ignition and consumption of the fuel, allowing coke to accumulate (coal from which the volatiles have been distilled). This would be a mild weather condition and is remedied by increasing the holdfire period.

Selection of Fuel

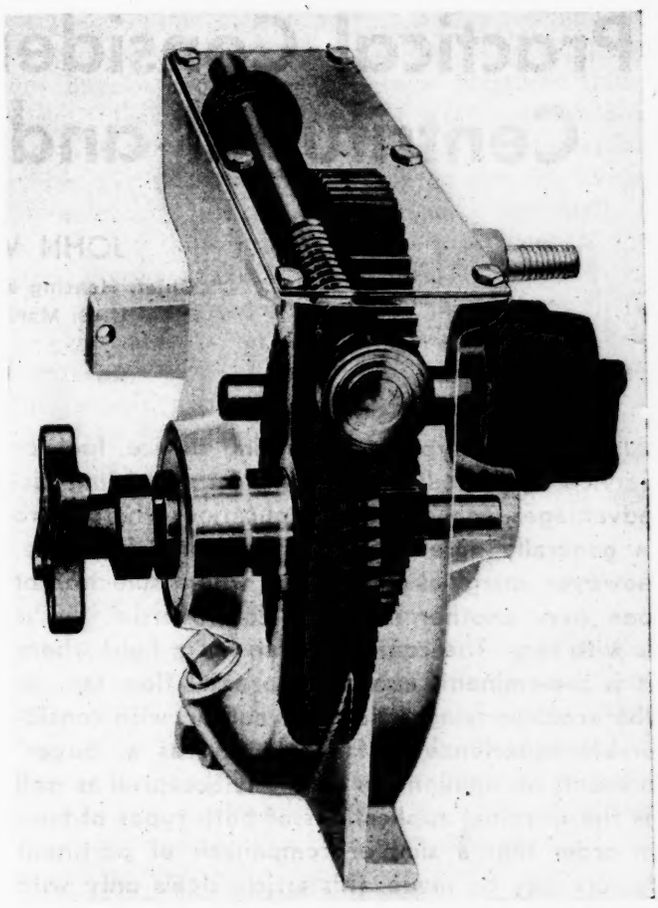
It is not feasible to establish a rigid set of rules for judging the value of a coal for stoker use, or to establish a specification to which a stoker coal must conform. There are too many variables affecting a coal's utility and preventing the setting of a standard. First there is the criterion of judgment or basis of evaluation. In domestic installations it might be said that ease of operation and freedom

from care and attendance upon the fire are the primary considerations. In commercial practice, however, cost of operation probably takes precedence over ease of operation.

Even the concept of clinkering is an elusive one. Nicholls and Selvig, of the U. S. Bureau of Mines, have stated that there is no direct answer to the question, Can clinker be predicted from the fusibility of an average mine sample of the ash? A main difficulty is the vagueness of the ideas conveyed by the term *clinkering*. An executive measures clinkering in terms of expense incident to the coal ash: direct labor, repairs, indirect labor and maintenance, reduced boiler output, and boiler outage. A fireman measures clinkering through his physical encounter with it: the actual effort in handling it, the time and trouble required to work his fire because of it. One operator will consider a coal highly clinkering because of the size of clinker formed in the fuel bed, another because of clinker toughness when hot, still another bacause of clinker adhesion to grates and the rapid destruction of them. No scale has yet been devised for measuring trouble—what one operator will accept without complaint another will stress.

There has been much discussion of coal size for stoker use. So-called nut-and-slack, and nut, are not precise terms. As applied to stoker fuel, the first implies a top size together with all smaller sizes down to dust, that is, everything that will pass through a screen designated by the top size, as 2 in. nut-and-slack. But the top size varies from 2½ in. to ⅜ in., according to local practice. Nut coal implies a coal having a top and a bottom size, with all coal larger than the top and smaller than the bottom size screened out, but there is no accepted standard as to either top or bottom size. In certain localities, a favorite coal size for stokers may be designated as pea size, or in some other manner. Actually, it has been shown by repeated test and reported in the literature, that the size of the coal as fed into the hopper does not always affect its combustion properties and, furthermore, that the coal size is altered in the coal feed tube. For most domestic stokers, a top size of 1¼ in. is the largest that can be put through the coal tube without placing too much strain upon the coal feeding mechanism, and larger coal sizes not only overload the stoker by increasing the work required to crush the coal, but result in noisy operation. Commercial sizes of stoker can feed somewhat larger coal pieces, according to the construction of the screw and tube, but there is likewise a limiting value to the coal size for proper operation; which size can be learned by consulting the stoker manufacturer or dealer.

One of the outstanding advantages of the coal stoker is the ability to burn high volatile coal without excessive smoke. But if volatile content is not a primary consideration in selecting stoker fuel, fusibility of the coal ash is important. Unfortunately, there is no precise information available on the optimum ash fusion temperature, because of the many variables: combustion rate; composition of the ash, especially the sulfur and iron content; design of the hearth; amount of "black" surface presented to the fire by the boiler setting, etc.



Phantom view of gear box and transmission shaft of a Stokerunit stoker.

Fly Ash

During operation of an underfeed stoker a certain amount of solid material is carried along with the stack gases and emerges from the chimney. These solids are not necessarily mineral or incombustible. Included may be small particles of fuel ranging from green coal to partially coked, coke, clinker, and unfused ash. The mixture is given the general name of fly ash. According to several authorities the amount of fly ash emitted by a domestic stoker may be as much as a bushel a week, and in industrial stokers the fly ash may amount to 1% of the coal burned. It has been shown that one inexpensive method for domestic installations is the use of a sheet metal settling chamber with baffle, located between the boiler and chimney, through which the stack gases are passed and in which the solids are caused to settle out by inertial effect. The efficiency of the device is quite satisfactory for particle sizes about 200 mesh, and the draft loss through it is negligible. It has also been shown that another method of abating fly ash is the suspension of a baffle above the fuel bed in the firebox, but this is not feasible in most cases because of high draft loss, interference with clinker removal, and impingement of coke trees. Recent improvements in air flow control and burner head design have minimized the fly ash problem.

Practical Considerations in Selecting Centrifugal and Axial Flow Fans

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Almost every type of competing device, fuel, or service has its advantages and corresponding disadvantages. Too, each has applications where there is generally agreement on selection; there are, however, marginal applications where selection of one over another is highly controversial. So it is with fans. The centrifugal fan has a field where it is pre-eminent, as does the axial flow fan. In the accompanying article the author, with considerable experience in fan selection as a "buyer" presents his opinions on generally accepted as well as the marginal applications of both types of fans. In order that a simpler comparison of pertinent factors may be made, this article deals only with direct-connected ventilation fans. Axial-flow fan, as used here, is defined as a propeller or disc type wheel within a cylinder.

PROPELLER fans with thin single-thickness blades (disc fans) are commonly used where free delivery or low static pressures (less than one-half inch water) occur. This use is based on the fact that the point of peak total efficiency is close to free delivery (70-75%) as shown in Fig. 1. Also, as noted in Fig. 1, the horsepower curve increases steadily toward the "block-tight" point of operation (0% of wide open volume). Furthermore, the horsepower is usually small and therefore any saving due to improved efficiency is too small to be of practical importance.

Centrifugal fans are usually used where static pressures are high (above about one-half inch of water) and where efficiency is of correspondingly greater importance because the horsepower requirements are much greater. Of the numerous blade forms available, the backward-curve wheel is generally accepted for most ventilation and heating applications, the principal exception being the use of the forward-curve wheel (Fig. 2) for small volumes and pressures which require very small horsepowers. The backward type blade is generally preferred because the maximum horsepower and maximum efficiency at any one speed occur at or close to the same point of delivery (see Fig. 3).

The forward-curve wheel has a horsepower-volume characteristic opposite that of the disc fan; that is, the horsepower curve rises steadily toward free delivery (100% of wide open volume), as shown in Fig. 2. Thus, if a fan system is miscalculated, and the actual static pressure is less than estimated, the forward-curve fan will require more horsepower than at the design point. If the motor is selected for the design requirements, then it would tend to be overloaded under actual operating conditions.

Fig. 3 shows the characteristics of the backward curve centrifugal fans. Note that the maximum efficiency occurs at about 60% wide open volume and the maximum horsepower occurs at about 70% wide open volume.

The present day axial-flow fan is a refined propeller device. Refinements consist of an aerodynamically designed blade (cast aluminum or hollow steel in most cases), precision tip clearances, control of motor frame size (to give proper ratio between motor and casing diameter), guide vanes for straightening the air flow, and, in some cases, tail pieces for stream-lining the motor. These improvements greatly improve efficiency and give a relatively constant horsepower characteristic (see Fig. 4) so that the motor will not overload except when the point of actual operation is very close to "block-

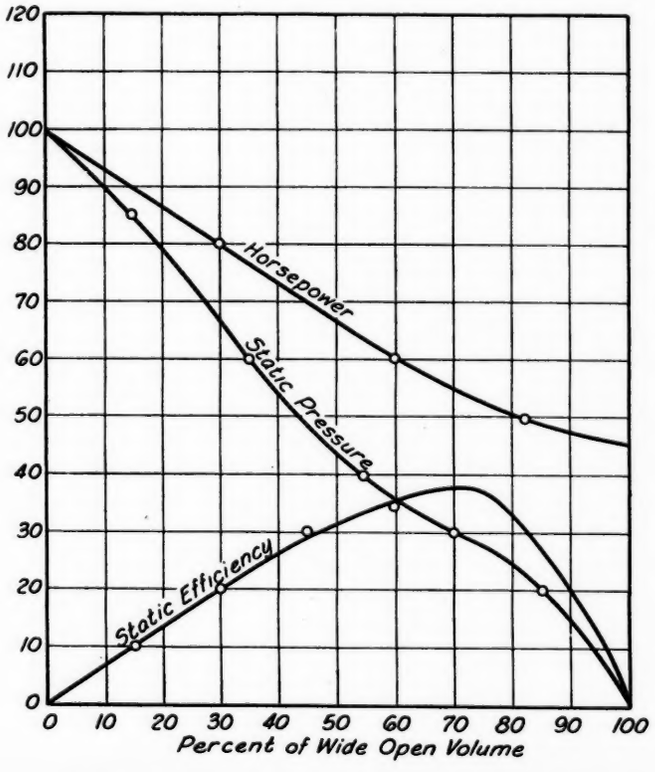

Fig. 1. Characteristics of a typical disc type fan.

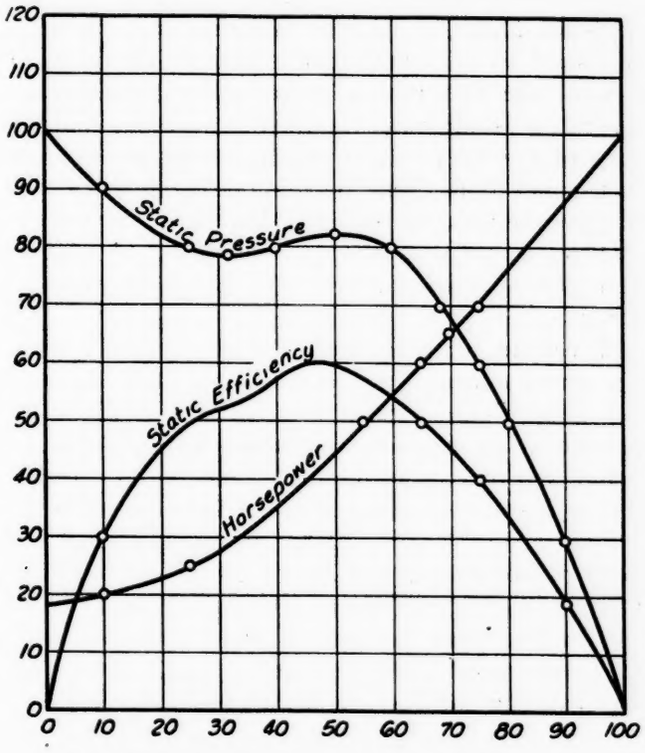

Fig. 2. Characteristics of a typical forward-curve blade centrifugal fan.

tight" (0% wide open) delivery. Also, the airfoil type fan is inherently much quieter than the propeller fan, other things being equal.

These refinements permit the airfoil axial flow type fan to be used in many applications which previously could be handled only by the centrifugal fan.

Theoretical Considerations

Axial flow type fans should be more efficient than centrifugal types because the air is disturbed less in passing through the fan. There are no right angle bends, and the restriction caused by the fan hub and motor can be faired to minimize the shock loss. The most efficient axial flow fans are built to very small tolerances and tip clearances. Whether similar accuracy would appreciably improve the centrifugal fan is questionable. With regard to the matter of an axial flow fan being more efficient than a centrifugal, it is essential that one realize that the former is tested with a larger size inlet cone than the latter (assuming a comparison is made on the basis of equal outlet and inlet velocities).

Some airfoil axial flow fans have a steeper static pressure-volume curve than a backward curve centrifugal fan designed for a specific static pressure and volume. However, this is not true in all cases. The static pressure-volume curve of most backward curved centrifugal fans is a smooth arc, while that of the axial flow fan has a hump and trough between the design point and the block-tight point of operation. The trough indicates unstable equilibrium, and operation in this range is generally avoided where quiet operation is essential. An examination of Fig. 5 will clarify this point. Note that a similar hump and trough exist for the forward curve centrifugal fan curve shown in Fig. 2. Some companies have been able to design axial flow fans which do not have a trough in the static pressure-volume curve. This characteristic is desirable because it increases the useful selection range. It is interesting to observe that the curves showing the relation of noise level to volume (for the axial flow fan) in Fig. 5 also show a high level at the trough of the static pressure-volume curve. This curve and the similar one for the centrifugal fan are typical. It is evident that fan catalogs should also include complete noise level data in order to determine fully the suitability of a fan. This is particularly true of the axial flow fan because the difference in noise level between no and free delivery (0 and 100% wide open volume) is greater than that of the centrifugal fan.

Practical Considerations

Perhaps the biggest attraction of the axial flow fan to the ventilation engineer is its compactness. This, like many packaged air conditioning units, frequently loses its practical advantage unless it can be installed in an accessible location. The centrifugal fan, on the other hand, may be said to have "natural" accessibility. The fact that an axial flow fan is smaller than a centrifugal one of equal capacity does not tell the whole story. It would be a fairer comparison if it were made on the basis of space occupied by unit plus space required for servicing.

Inspection and access doors provided in axial flow fan casings are considered inadequate by many engineers. While these openings permit inspection, they provide little room for maintenance, particu-

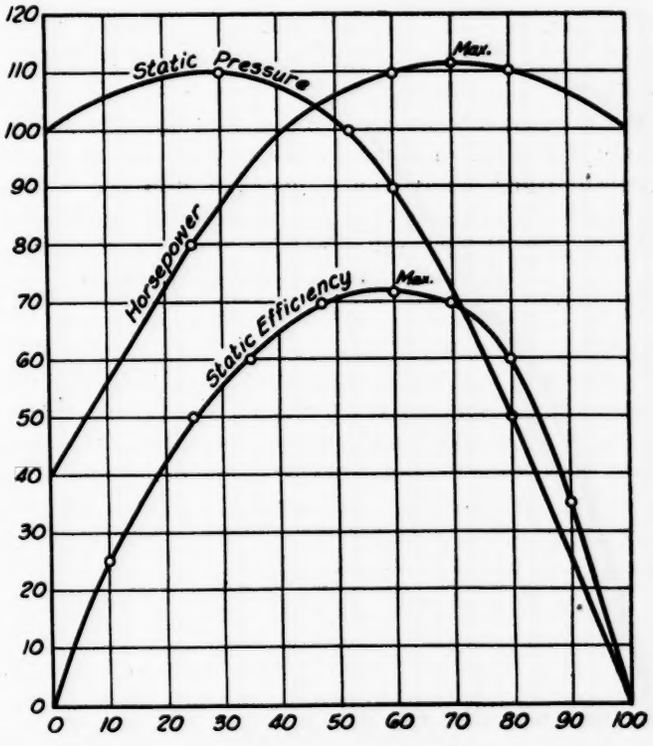

Fig. 3. Characteristics of a typical backward-curve blade centrifugal fan.

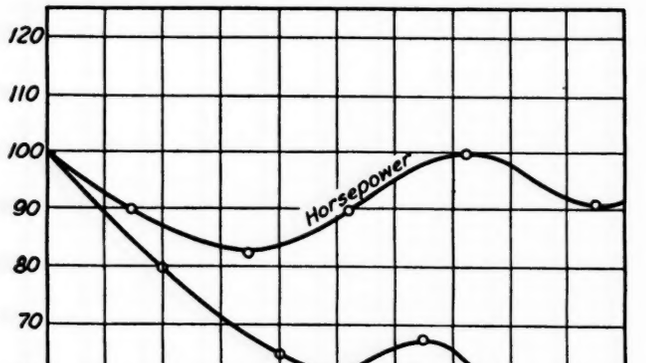

Fig. 4. Characteristics of a typical airfoil type axial flow fan.

larly where direct current motors are concerned. In many instances, these openings are not accessible. While means for lubrication are fitted on the outside of the casing to facilitate servicing, both the grease fittings and relief plugs frequently are inaccessible.

It naturally follows that the smaller the axial flow fan, the smaller the inspection and access doors. This means that on the smallest sizes they are practically useless. Also, the largest possible access provided in the adjacent duct may not be adequate for servicing, even if located in the most suitable positions. Thus the fan unit must be removed from the duct before it can be serviced under these circumstances. On the larger sizes, conditions are more favorable, and, in some cases, may be better than that afforded many centrifugal fan motors.

While in a laboratory it is possible to determine the fan speed with the usual instruments, it is impossible to do so on many installations where the fan is installed with ducts upstream and downstream. If the access plate is removed, the system is changed. Although, technically, this may not be considered essential, the personal danger to those attempting to use a tachometer is evident. The use of a Strobotac is not always convenient, and determination of speeds by getting the pitch of the fan noise is not possible unless one is particularly trained to use this method.

It has been definitely proven that the axial flow fan performance is easily affected by the direction of the approach air. Some manufacturers are conducting considerable research on this problem in order that a satisfactory solution can be obtained. Fig. 6 illustrates this point. While the centrifugal fan is generally believed to be less sensitive to this approach factor, it must be said that little has been published to substantiate the belief. However, in view of the fact that a centrifugal fan's efficiency depends to some extent upon the positions and designs of the inlet box, and that eccentric upstream duct connections both decrease the efficiency and increase the noise of the axial flow fans, it is reasonable to assume that the noise characteristic of centrifugal fans is also affected to some degree by this factor.

A certain standard series of comparable axial flow and backward curve centrifugal fans indicates that a maximum efficiency of 78% and 75%, respectively, is considered reasonable with direct connected motors operating at synchronous speeds. This series contains fans between 1,000 cfm and 1.5 inch static pressure to 10,000 cfm and 2.00 inches static pressure, and utilizes standard size motors. It is true that in the above series some of the axial flow fans may have slightly higher efficiencies than the centrifugal type, but in view of the fact that standard size motors are commonly used, little is actually gained in this range of sizes. With both larger volumes and higher static pressures, the efficiency will pay a premium because a smaller size motor may be used and less power is required to operate the fan. Also, in the above series, the centrifugal fan speed is 1750 up to and including the 5000 cfm size and 1150 above this size. All of the axial flow fans operate at 1750 cfm. Furthermore, manufacturers frequently raise motor ratings when used on direct connected axial flow fans. Obviously, the cost of the smaller motor should be less. However, this may be countered by the additional cost of special motor frames for the axial flow fan.

There are many cases where a centrifugal fan can fit in better than an axial flow fan. In almost all systems elbows occur which form an ideal place for utilizing the fundamental turning effect of the centrifugal fan. This turning effect forms part of the basic fan performance, and, therefore, no allowance is required for the elbow loss. Where a straight run of duct occurs from one end of the system to the other, the axial flow fan is the natural choice. Of course, if the static pressure is low, the propeller fan may work in favorably, too.

Many users of axial flow fans consider it good practice to provide waterproof motors on all direct connected propeller and axial flow fans. However, waterproof motors are only provided on centrifugal fans exposed to the weather. Generally speaking, a larger motor frame size will be required on the waterproof motor, thus increasing the overall cost of the fan unit.

While the centrifugal fan may take more space in some instances, the advantage of having the motor outside the air stream frequently overcomes the space disadvantages. This applies to exhausts from food preparation spaces, forges, spaces containing volatile explosive vapors, and similar systems where excessive heat, grease, dirt, or explosive mixtures are present. Special motor enclosures to suit these

circumstances will, of course, increase the cost of the axial flow fan. Also, such motors are still scarce.

Few projects are created without considering cost. While in the larger size axial flow fans appreciable space may be saved and higher efficiency may possibly be obtained, the cost of special motors, more accurate production methods (closer tolerances, better materials, etc.) may prove prohibitive on the basis of first cost. Furthermore, if maintenance is more difficult, the saving in power consumption may be exceeded by greater labor and replacement costs. Weighing of all factors must be done before one type fan is considered superior to the other for a specific application.

Standardization

Standardization of ventilation equipment has materially progressed since the war started. It is hoped that the common sense of such a practice will be retained in the future irrespective of military considerations.

The large number of variables, which govern a fan's performance and physical suitability, necessarily make it difficult to standardize. However, each industry has its own peculiarities, and, while it may not be possible to standardize on fan designs for all uses, each industry can standardize itself.

The art of fan selection and the conditions of operation make it unnecessary to select each fan on the basis of the last cubic foot per minute or hundredth of an inch static pressure. This can be easily proved by having any two average engineers estimate the capacity and static pressure of a fan for doing a certain job. It, therefore, follows that the standardization of fans for a particular industry should be adopted as a reasonable method for increasing production, decreasing cost, improving performance (lower decibel ratings, higher efficiency, etc.) because of concentration on a relatively few models, and simplification of ordering, replacement and system design.

Airfoil axial flow and propeller fans definitely lend themselves to standardization because they are by nature suitable for all positions of mounting. Considering the numerous errors which are made in ordering centrifugal fans with improper discharges and mountings, this advantage is of prime importance. Furthermore, the axial flow fan does not concern itself with rotation, and, if the standardization provides for all waterproof motors, still another variable is eliminated. There are no variables present which affect the physical features of the fan itself. Only the motor and controller are subject to modification to suit the characteristics of the installation. Even where the centrifugal fan is designed convertible as to discharge, it is not convenient or practicable to accomplish this adjustment on the job.

The centrifugal fans of various manufacturers included in the standard series mentioned have relatively close static pressure-volume characteristics, within the useful range. However, the same curves for the axial flow fans vary considerably in the same range. It is not uncommon to have one manufacturer's fan deliver 130% and another 170% of the design volume at free delivery (no static pressure). While fan engineers claim that they can design to get any desired characteristics, progress to date indicates that this may not be easily accomplished. Obviously, for true standardization, the same size fans of all various manufacturers must have reasonably close characteristics to insure interchangeability.

Summary

Introduction of the present axial flow fan cannot be considered the solution of all fan engineering problems. Just as the modern centrifugal fan re-

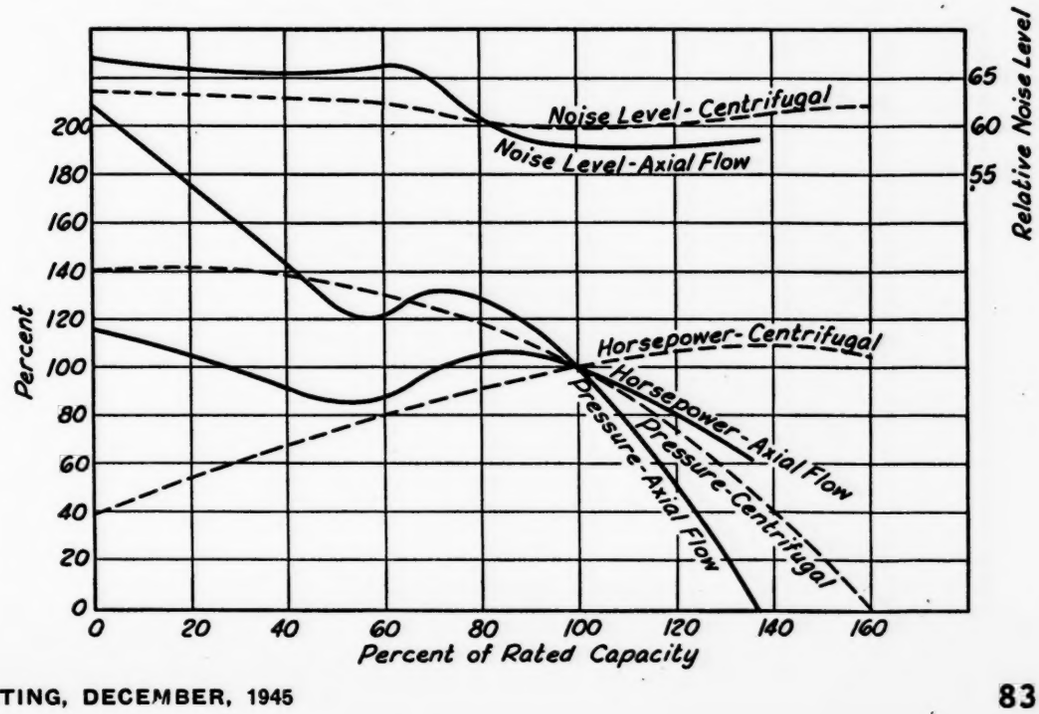

Fig. 5. Curves showing relative performance of centrifugal and axial flow fan having same horsepower requirements at the design point.

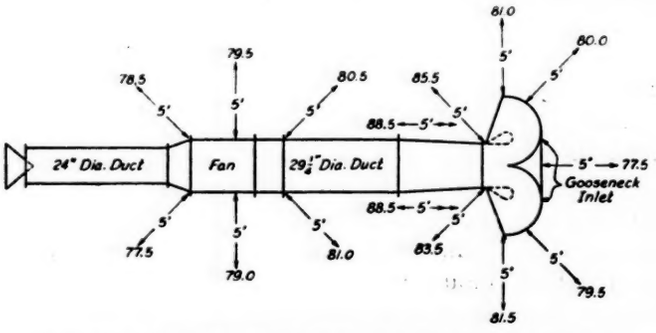

Fig. 6A. Sketch showing sound readings with an axial flow fan with double gooseneck inlet. Readings are in decibels, distances in feet; in this test, as with results shown in Figs. 6B and 6C, fan rpm was 1750, air volume 12,000 cfm.

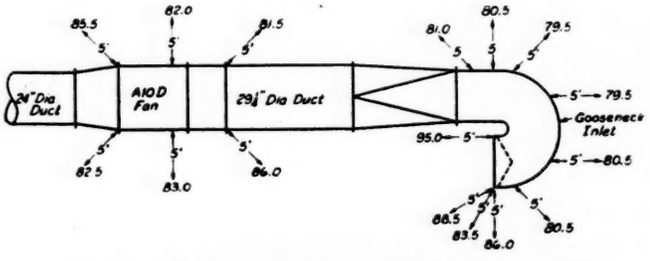

Fig. 6B. Noise readings for axial flow fan with single gooseneck inlet. See Figs. 6A and 6C.

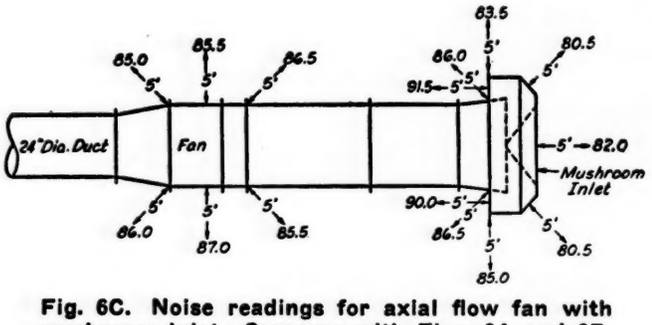

Fig. 6C. Noise readings for axial flow fan with mushroom inlet. Compare with Figs. 6A and 6B.

placed the earlier screw fan for certain applications, the axial flow fan will replace the centrifugal fan in many instances. It must be understood that there are many varieties of axial flow fans to do certain jobs, just the same as there are many varieties of centrifugal fans. Axial flow fans are most suitable for high pressure, large volume systems, where their compactness and higher efficiency overbalance higher first costs. Also, the axial flow fan is particularly suitable for systems operating on alternating current where motor maintenance is comparatively simple. Each job has its own peculiarities which will determine the type fan most suitable to use.

Development of the present day axial flow fan is still in its infancy. If these fans are to serve their maximum usefulness, it will be necessary for ventilation engineers to be educated properly to apply and install them. This statement should not be considered singularly detrimental to this type equipment, as it is equally applicable to other types of fans. Furthermore, manufacturers must accept this educational responsibility as being equally important as the development of more efficient equipment if the improvements are to be considered something more than only laboratory accomplishments.

A true comparison of equivalent fan performance will necessitate further progress of sound engineering, in order to put it in a form suitable for including data in catalogs. This will also necessitate considerable correlation of the various factors involved, to permit engineers to anticipate fan noise on actual installation, based on values obtained from standard test codes. The relation of fan noise and efficiency appears to be such that improvements in noise reduction may, in general, also improve efficiency.

More Light on Dust

To the highly versatile electron microscope has been added still another important function: the determination of the size, distribution, and shape of infinitesimal particles of dust and pollen in the air. A subject of considerable interest to the air-cleaning industries, the study of these particles has been limited by the magnifying power of the light microscope, which can give information only on particles above five microns in size (about .0002 in.).

But the electron microscope, with its magnification of up to 50,000 diameters, can recognize particles as small as 0.005 micron, and can determine the form of those 0.02 micron or larger. Doctors E. A. Gulbransen and R. T. Phelps of the Westinghouse Research Laboratories are making such studies on particles of dust, tobacco smoke, and pollen, collected from smoggy, rainy, and clear atmospheres.

Because the electron microscope can penetrate matter to a depth of only 0.01 to 0.05 micron, the specimens must be collected on an extremely thin film of collodion or other plastic material. This in turn is mounted on a 200-mesh stainless-steel screen ⅛ inch in diameter. Tobacco-smoke particles can be collected by holding the film and screen in a trail of smoke for a few seconds. Dust can be gathered electrostatically by making the specimen the negative electrode and a fine point the positive electrode. A large collection of dust, smoke, or pollen can either be dusted on the screen or film, or dispersed in water and a drop evaporated on the screen.

The studies Dr. Gulbransen and Dr. Phelps have made so far show the effectiveness of the electron microscope in studying air-cleaning problems. Not only can the nature of the foreign material in the air be studied, but also the efficiency of the air-cleaning process itself can be evaluated.

Air Cleaners for Internal Combustion Engines

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Dr. Silverman's article, presented in three parts, of which this is the first, gives readers an opportunity to look over unusual applications of air cleaning techniques. The reported investigations apply a novel approach to air cleaning problems, and their conclusions are independent of usual ventilation data. Several descriptions and illustrations are from Bulletin 499 of the University of California Agricultural Experiment Station.

THE advancement already made in mechanical refinements and perfected systems of lubrication for internal combustion engines should prove sufficient to meet all present demands were it not for the dust conditions and the problems that dust presents. In the majority of cases, the cause of unsatisfactory operation is traceable directly to the wear of moving parts. This wear is caused largely by the admission of abrasive material through the carburetor or crankcase breather. Dust is the principal reason for the high costs of engine and chassis repairs. As vehicles become stabilized and radical changes become less frequent, equipment will no longer be discarded because of antiquated design and longer engine life will be of paramount importance. Prolonging the life of the engine must logically involve lessening of wear of all internal moving parts. Road dust is the chief offender. In wartime, dusty conditions may prevail in the battlefield such as occurred in the Libya campaign. Since all mechanized equipment is powered by internal combustion engines the need for air cleaning devices is even greater than in peacetime.

Analysis of the so-called carbon deposits in an engine show from 15 to 25% silicon. The carburetor mixture requires one part of gasoline to fifteen parts of air by weight. Translated into volume, one gallon of gasoline burned requires more than 10,000 gallons of air. The dust carrying possibilities are very great. In extremely severe cases, automobile engines and truck engines have been found to need repair after 4000 to 5000 miles, while instances are on record of tractor and shovel engines, not protected, wearing out in 6 to 12 days of service.

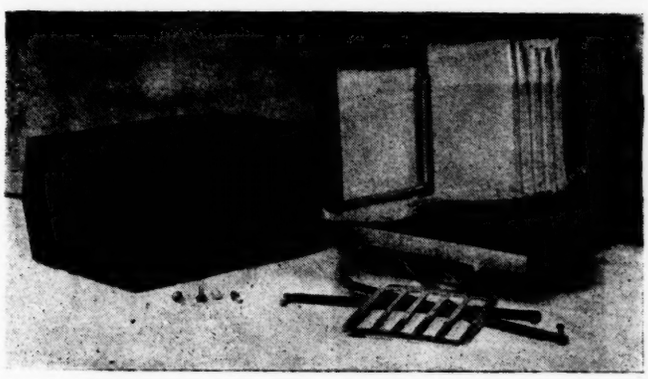


Fig. 1. Annis dry felt filter (disassembled). Each of the flat felt bags (10 in this model) forming the filter element is drawn over a wire frame. The two aluminum grids and iron bars hold down the filter element, prevent air leakage, and maintain the ½-inch spacing between the bags. New felts may be put in when needed.

Two coaches, one having an engine equipped with an air cleaner, the other without, were driven 400 miles a day in opposite directions. At the end of 30,000 miles, the valve seats and pistons of the engine without the air cleaner needed regrinding. In the coach with the engine equipped with an air cleaner, after traveling 100,000 miles not a valve needed to be reground. In the Imperial Valley, a test was made before putting an air cleaner on a certain car; without the cleaner, this car needed overhaul in 10 months. After installation, the car was operated for 17 or 18 months. A decrease in the repair costs of air compressors was also found when they were equipped with air cleaners.

The examples cited show the necessity for providing clean air for the intake and crankcase breather of internal combustion engines. Experience has shown that an air cleaner is of great benefit where there is an excessive amount of moving air such as wind. The dust problem is not so serious to those who use their automobiles and trucks on paved roads only or who expect to 'turn in' their machines as soon as the high gloss is worn from the enamel or the upholstering becomes a bit shabby; but it is often very serious to those who must use dry earth roads and get long, economical service from their machines. The farmer, probably more than anyone else, uses motor vehicles in fields and orchards and on unpaved roads where dust conditions are often extremely severe; hence for him the air cleaner is of especial importance.

The action of an air filter depends upon one of the following principles:

(1) Electrostatic precipitation.
(2) Washing.
(3) Mechanical separation.
  (a) Straining through gauze or felt.
  (b) Centrifugal force.

It is rather obvious that the first two methods are ruled out for automotive work, but there is a possibility of their use in stationary engines. However, unless the engines are extremely large, the cost of filtration by the first two methods may be prohibitive. The third method is the one used commonly

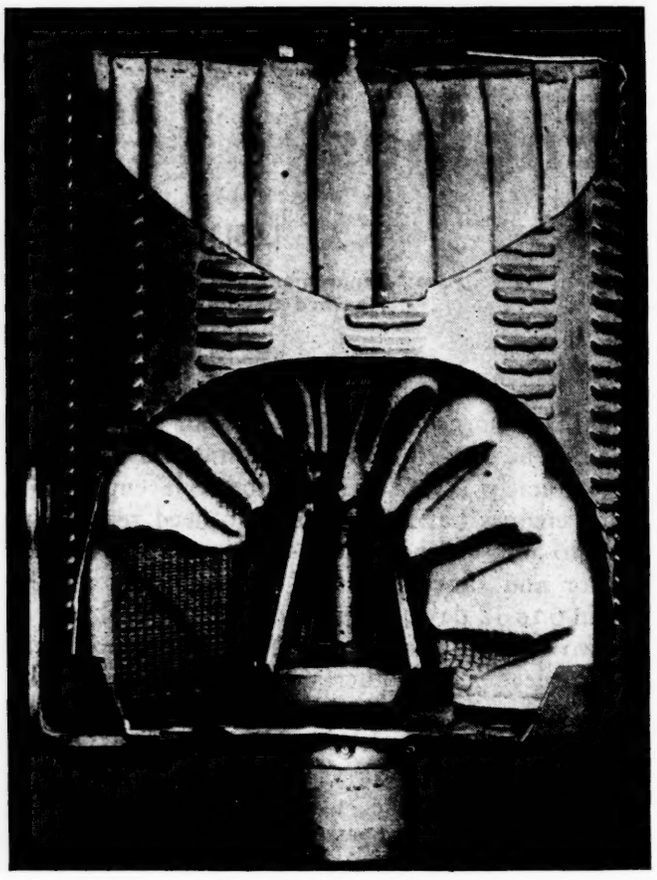


Fig. 2. Protectomotor. (Parts of shell and filter element are cut away.) By removing the cap at the top and applying an air hose to the perforated central tube much of the accumulated dust may be blown out. Note the method used to secure large filter area in small space.

in the automotive field and for small stationary engines.

Requirements of Air Cleaning Devices

The primary characteristics of a satisfactory air cleaner are (1) efficiency in separating dust from the air, (2) little restriction (often called choking or vacuum effect), (3) small size (compactness), (4) infrequent need for servicing, (5) simplicity of design and construction, (6) freedom from troubles, (7) ability to muffle carburetor noises and to prevent ignition of gasoline from backfires, (8) sturdiness, neatness, durability and low cost.

In order to accomplish its purpose, the cleaner must have sufficient size and capacity to handle the air required by the engine at all speeds and loads. The variation in speeds and loads of the average engine is such that the cleaner is required to remove dust effectively at all rates of air flow, varying from no load, idling speed up to full load and full speed. It should be able to maintain a high efficiency for a reasonable time with the entrance of dust laden air, or, if the density of the dust be less, it should operate for a correspondingly longer period before the attention of the operator is required.

Next to efficiency in importance is the restriction effect (often called vacuum effect, or choking effect). If this effect is large, carburetor action may be interfered with and loss of power and inefficient use of fuel may result. In an extreme case, the restriction, unless the carburetor can compensate for it, may cause so much choking that raw gasoline may wash the lubricating oil from the cylinder walls and permit metal to metal contact, with resultant rapid wear and, possibly, scoring. In some of the new cleaners, the designers have sacrificed efficiency to secure a negligibly small restriction. In some other cleaners they have secured high efficiency without undue restriction.

To the designer and builder of the engine, the size of the air cleaning device is a factor which merits most careful consideration. As the usual desire, from the engine manufacturers' viewpoint, is to keep the size of parts as small as possible and to reduce the cost to a minimum, other factors are sometimes overlooked in stressing these points. If care and thought be given the air cleaner, as an essential part of the machine early in its design, it should not be necessary to sacrifice efficiency or dust handling capacity because of limited space available provided the air cleaner selected has well balanced characteristics. Usually space under the hood of an automobile is at a premium; hence the smaller the cleaner that can do its work satisfactorily, the more acceptable it will be. Also the simpler its construction and the less it is burdened with moving parts and connections to exhaust or intake manifolds, the more readily will the engine designer give it a place.

Some automobile manufacturers have been reported as insisting that no air cleaner will be satisfactory to include as standard equipment on their product if it requires any attention or servicing. This demand, if strictly adhered to, would bar all air cleaners, since all require some attention. No cleaner now on the market can be installed and then forgotten, and still under all circumstances, month after month and year after year, afford satisfactory dust protection and not interfere with carburetor action. Some of the best cleaners can do an excellent job under normal dust and running conditions for upwards of a year without attention, but all cleaners efficient enough to be worthy of the name should be given some care, at least as often as the oil filter (once each 1,000 to 10,000 miles).

Many air cleaners effectively muffle carburetor noises. Some undoubtedly reduce the danger of gasoline being ignited by backfires. The principle

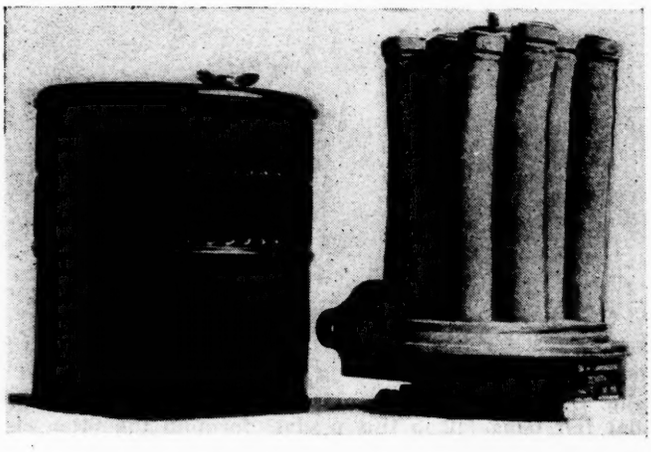


Fig. 3. Zenith. Two concentric shells form dry centrifugal cleaners in series with the tubular felt filter. Within each felt tube is a spiral spring.

involved is the same as that employed in the Davy safety lamp, formerly widely used by coal miners to prevent explosions when inflammable gases came into contact with the flames of candles or wick flames. Many modern air cleaners chill the burning gases of a backfire and reduce their temperature below that which would ignite vapors of gasoline (from leaky carburetors, tubes and connections) and so reduce the hazard. Cleaners of other than screen type may also have this property. The essentials are that the individual air passage be very small and the materials capable of absorbing heat readily.

General Classification

The general basic classifications of air cleaners according to the process involved are (1) dry inertia type, (2) dry and wet filter strainer, and (3) liquid washed filter strainer. These form the primary processes involved, but in certain devices more than one of these methods is used so that a combination of the simplest types is obtained.

(1) In the inertia type (mostly all of which are dry centrifugal cleaners) the air is directed in a curvalinear path. Due to this whirling action and the velocity of the air, the heavier dust particles are thrown outwardly and separated from the air. They are then either caught in a receptacle or rejected according to the method employed.

(2) The filter strainer type of cleaner depends upon passing the air stream through a filtering material in which the dust particles are caught, permitting the cleaned air to pass on to the engine. The filter used may be fibrous such as felt or other closely woven material in which the air spaces are very minute. Or, the filter material may have large openings for the air to pass through. In this case, the filter element is usually saturated with some liquid such as oil, so that dust particles making direct contact with the wet surface will cling to it.

In all cases of the filter type it is necessary that the dust be periodically removed from the filter element, and if a liquid is used for coating the element, that it be replenished to supply the required film to retain the dust.

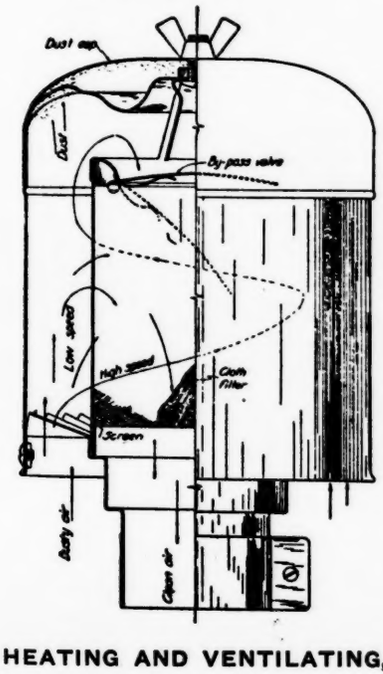


Fig. 4. Tillotson (shown partly broken away). The cloth filter in the middle is designed to operate at low speed. At high speed a by-pass valve opens, and cleaning thereafter is by centrifugal action.

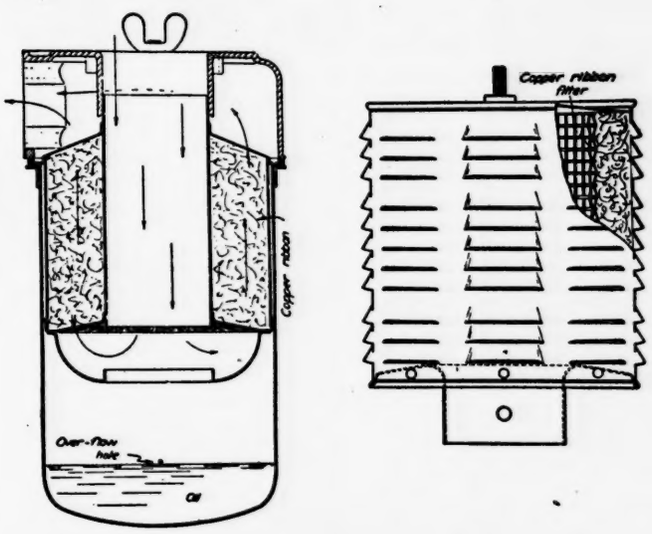


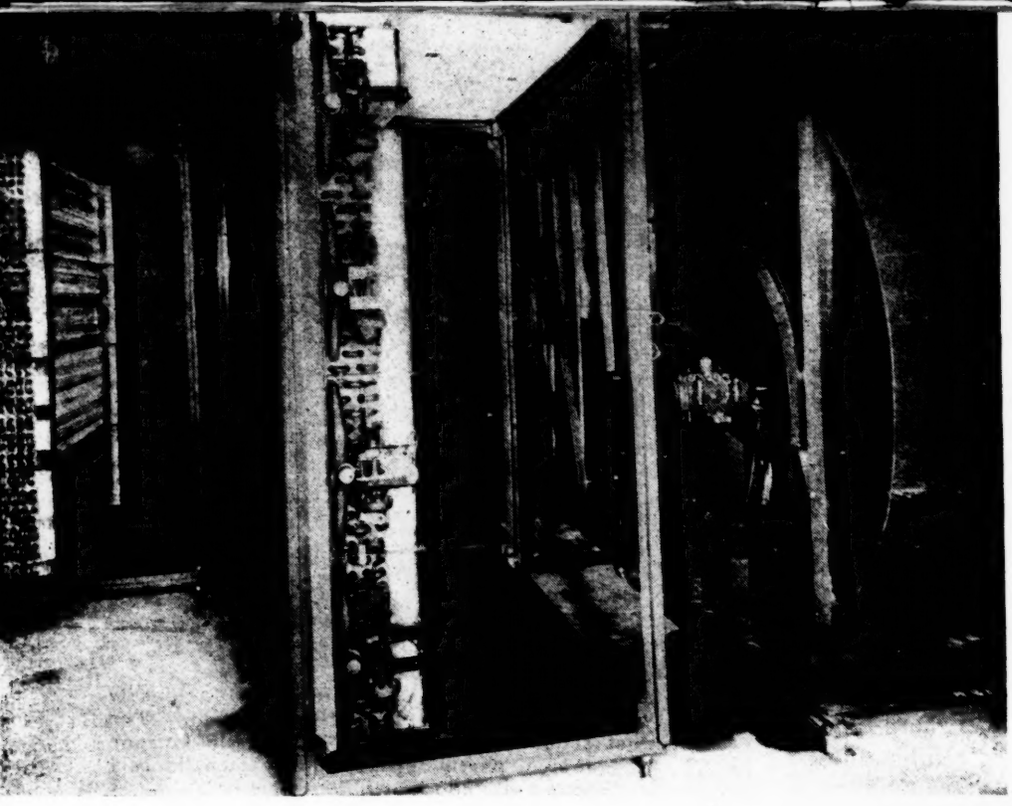
Fig. 5. *(Right)* **AC Triplex (section view); a loosely packed oily copper-ribbon filter, not self-washing. The coarser dust tends to fall into the oil at the bottom.** *(Left)* **AC (shown partly broken away); a loosely packed oily copper-ribbon filter.**

(3) The liquid washed type of air cleaner is so designed that the air stream comes into contact with a liquid, usually oil. The dust particles then cling to the surface of the oil and settle compactly in the dust receptacle. The effectiveness of this process depends entirely upon the degree to which the air comes into contact with the liquid. Most cleaners of this type employ two or more of the primary processes, and the efficiency attained is largely due to the coordination of these methods rather than to an increase in the efficiency of each process.

For instance, if the centrifugal is combined with the filter strainer process, the heavier particles will be eliminated by the centrifugal action, while the lighter particles will be retained by the filter element. This relieves the filter portion from being loaded by the heavier particles, with the result that the period of operation between servicing is lengthened materially over the case where the filter strainer method alone is used. Also, by combining the strainer filter with centrifugal action it is possible to construct a cleaner having a lower restriction than if either process is employed individually, assuming that the efficiency is approximately equal.

If the liquid washing method is combined with the other two, the coordination permits the centrifugal action to be more effective than if used alone, for lighter particles are more easily removed from the air stream if in the centrifugal action wet surfaces are provided to which the dust may adhere. Also, when combined with the filter element, the action of the liquid by washing down the collected dust, reduces the attention required for maintaining the element in condition for continued high operating efficiency. The results obtained by combining these processes give a cleaner of balanced and coordinated characteristics to meet the varied requirements of a cleaner designed to give the most efficient service under actual conditions in the field.

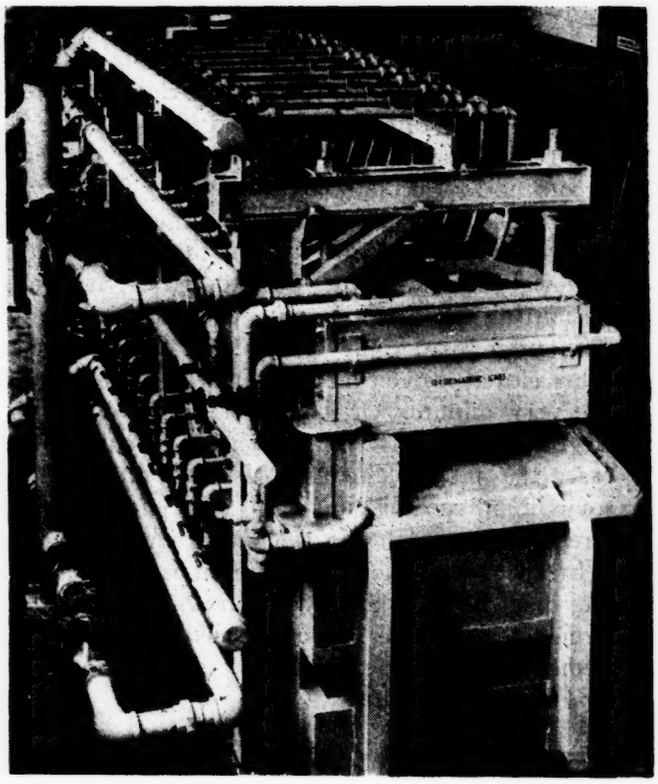
Next month Dr. Silverman discusses performance characteristics of various types of air cleaners.



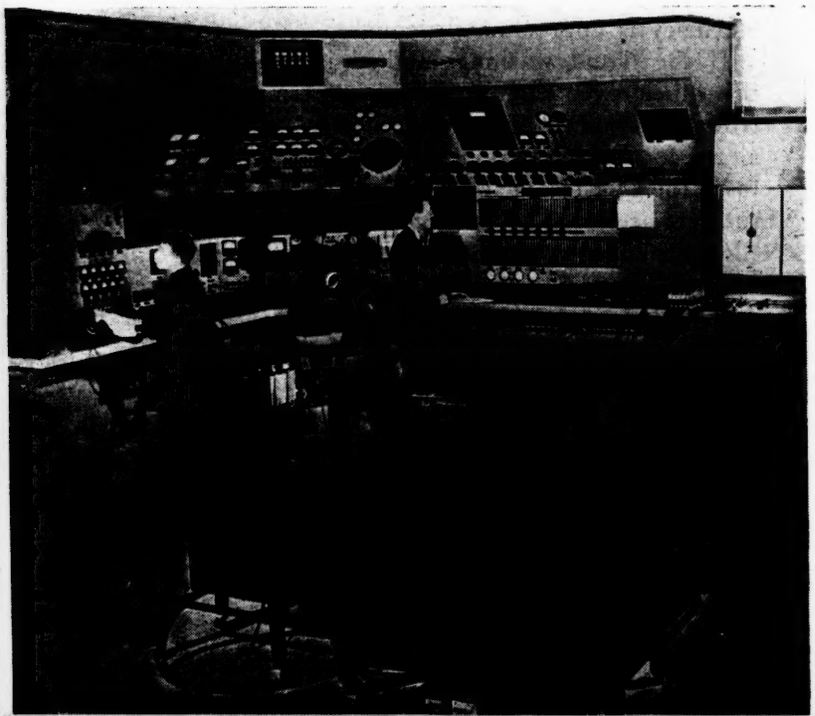
Picture Paragraphs

(Above) Installing General Electric air conditioning in basement of Proctor's theater in Troy, N. Y. Each of two sections made up of four G-E direct expansion coils is installed adjacent to fans.

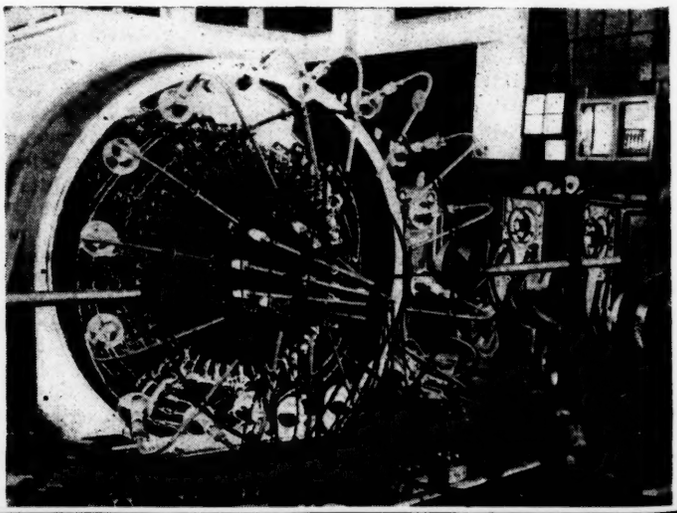
(Right) A pressure loss problem in the 3 lb per sq in. manifold of this Selas continuous process gas furnace was solved by funnel-shaped inlet of Weldolet fittings in place of nipples welded into manifold.



(Below) Control panel of Southern California Cooperative Wind Tunnel at Pasadena, Calif., made by Westinghouse, shows forces acting on models under test. Readings are indicated on dials at right and recorded automatically on machines in foreground.



(Below) Insulating varnish is baked onto generator by internally heating winding with direct current from two Hobart welders in series with infra-red lamps maintaining a temperature of 250F for 12 hours.



Evaporative Cooling for Textile Mills

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The accompanying article relates specifically to practice in the Argentine, but a large portion of the author's thesis applies to North American practice as well.

IN consequence of the war Argentina's import in textile goods, fabrics and yarns suffered a very marked decrease. As a reaction, this country's textile industry expanded very strongly and at a rate that hardly could have been imagined before. Old factories were enlarged and new ones built to meet the needs of the local as well as foreign market. It is natural that such a flourishing industry should endeavor to improve the quality of its products and to create better working and sanitary conditions. In consequence, the interest of manufacturers was led more and more towards the installation of modern air conditioning equipment.

It is generally known that textile mills cannot work successfully without a humidified atmosphere and that in order to create best working conditions the relative humidity of the air has to be a specific one for every kind of raw material and for every phase of the manufacturing process. It is perhaps not so generally known that the exact regulation of the relative humidity in the workshops is nearly as important as the humidifying itself. Great care must be taken to avoid any sudden changes of humidity, which may cause serious disturbances and great damage, such as the break of yarns, which would paralyze for hours the production of a whole mill. It was reported that in one important textile mill before installing air conditioning equpiment, on a day when there was a sudden decrease of relative humidity, within half an hour every yarn on the machines was broken, with consequent loss of thousands of dollars.

The climate of Argentina is what generally is called a moist climate and it was this circumstance which, in the earlier stages of the textile industry, caused some doubt and discussion as to whether it was necessary to provide artificial humidifying or not. In fact even recently several textile experts stated that under local circumstances there was no real need of moistening the air of the working rooms. These, of course, are opinions of the past now, and actually there is hardly a textile mill of importance in the Argentine which does not have some kind of humidifying equipment or would not consider the purchase of such equipment. Lately very high prices of materials, which caused a marked rise in air conditioning equipment, and the belief that in the postwar period this apparatus will be obtainable at a much more convenient price, prevented quite a number of manufacturers from providing modern equipment for their plants or from changing their obsolete direct spray moistening apparatus for an air conditioning installation based on evaporative cooling.

The climate of Argentina is actually very damp —for comfort—but not damp enough by far for textile mills, especially during the summer months. Even supposing the conditioning of the outdoor air would be satisfactory, the high rate of heat produced by the machinery would always dry the air much more than would be desirable for good working conditions; moistening is often necessary even in winter, when the outside relative humidity is rather high. However, on the whole, in the Argentine humidifying is a summer problem, and in consequence every system which is designed for moistening the air must be examined first under summer conditions.

Winters Are Mild

To a North American engineer it may perhaps seem strange that humidifying is not always necessary in winter, since in the U. S. there is always a definite need for humidifying in winter, even for comfort purposes. At this point it has to be considered that winter in the Argentine is not nearly so severe as it is in most parts of the U. S. Basic design conditions for Buenos Aires generally are taken as 36F and 95% r.h. Sometimes design conditions are taken also as 32F and 100% r.h. However, these conditions apply really only in the early morning hours and would affect textile mills only when they are working 24 hours, and even then only if they are heated to more than 50-55F, without taking most of the air from return.

An outside condition of about 45-50F with 85-90% r.h. could be considered as representative during daytime hours for the Argentine winter. Under this condition, mills which are heated only by the heat output of the machines can work often without humidifying of the air, and so did a great many mills up to recently in this country.

Naturally, these are far from best working conditions, as for these the temperature has to be kept above a minimum, but the temperature has always been considered a secondary factor in the textile industry and it was not recognized until lately that

temperature is not only a comfort, but a manufacturing factor as well.

Summer design conditions for Buenos Aires are 95F d.b. and 40% r.h. At this temperature the relative humidity rarely is higher than 40%, but it happens on some days every year, just as there always are several days with higher temperature as well. It is quite satisfactory for comfort installations to be based on design conditions which will be exceeded on an average of five or six days every year, but it may cause trouble in industrial plants, especially as the wet bulb temperature frequently exceeds the limit of 75F, corresponding to 95F dry bulb temperature and 40% r.h.

It has been proposed, therefore, to take 95F dry bulb temperature and 48% r.h. as design conditions for air conditioning installations serving industrial plants, considering the damage that could be caused if this equipment should fail to establish inside design conditions for a number of days. It would seem natural to assume that when designing a humidifying installation, it would be more pessimistic to take the lower relative humidity as the design condition, as the air would need more humidification to reach the inside design conditions, and therefore this design would have a greater safety margin. This is really the case for direct moistening equipment which does not perform any other function besides adding water in form of a spray to the air of the room, and naturally has to distribute more water into dry air than into moist air.

Dry Air May be Better

Evaporative cooling equipment, on the contrary, performs much better if the outside air contains less moisture. This system in summer operates with 100% outdoor air. The relative humidity of the air leaving the apparatus to be described later being practically independent of the relative humidity of the entering air, more water may be evaporated into the air in the apparatus if the entering relative humidity is lower. In consequence the dry bulb temperature of the air leaving the apparatus will be lower if the relative humidity of the air entering it is lower, which results in a lower inside dry bulb temperature, supposing the inside relative humidity is maintained unchanged. However, the dry bulb temperature being only a secondary factor in the air conditioning of textile mills, it is customary to base the inside dry bulb temperature on 95F and 40% r.h. as design conditions, since in this manner more advantage is taken of evaporative cooling, which consists in the effective lowering of the dry bulb temperature. It is not at all incorrect to proceed in this way, because in an overwhelming majority of cases at 95F the relative humidity remains below 40%, too, permitting the equipment to give a still better performance than the one which is based on 40% outside relative humidity.

Up to about 1941 the system almost exclusively used in the Argentine consisted in moistening directly the air of workshops by spraying water into it in the form of fine mist. Generally, three types

TABLE 1.—COMPARISON OF OPTIMUM TEXTILE MILL CONDITIONS.

Material	Process	ASHVE *Guide* Data		European Data*		Argentine Practice
		Dry Bulb Temp., F	Rel. Hum., %	Dry Bulb Temp., F	Rel. Hum., %	Rel. Hum., %
Cotton	Carding	75-80	50-55	72-77	50-55	without humidifying
	Combing	75-80	60-65	75-77	75	70-75
	Roving	75-80	50-60	72-88	55-60	55-60
	Spinning	60-80	50-70	72-75	65-70	65-75
	Weaving	68-75	85	65	75-85	65-75
Rayon	Spinning	70	85	74-78	65-70	
	Throwing	70	85	72	80-90	
	Weaving	70-88	60-75			65-75
Wool	Carding	75-80	65-70	72	60-80	70-75
	Spinning	75-80	55-60	75-77	70-90	80-90
	Weaving	75-80	50-55			80-85

*Kestner & Neu.

of system were employed to raise the relative humidity; two of these were widely adopted in this country, one using compressed air to atomize the water, the other atomizing by mechanical means. The compressed air system needs a central air compresser, failure of which means shut-down of the whole system; it requires the installation of a great deal of piping. The mechanical spray system consists of individual units, but these generally do not atomize in very fine particles. Disadvantages of both systems consist of the unequal distribution of humidity and difficult automatic regulation. The only real advantage of a direct moistening system is that it is possible to maintain practically any relative humidity up to 90% or even more. Besides these two systems, there is a third one which uses steam for heating and humidifying the atmosphere. This system, which obviously can be used only for winter humidifying, is not popular in the Argentine where, because of the climate, the humidifying of textile mills is mostly a summer problem.

The purpose of conditioning the air in the textile industry may be summarized as follows:

1. To produce merchandise of better quality. Yarns spun in a moist atmosphere when examined under a microscope prove to have a much more smooth and uniform surface. Cotton yarns spun in moist air are stronger, there are less breaks of yarns and, therefore, the fabric produced in these conditions has fewer imperfections;

2. To increase the amount of production by eliminating the causes of shut-downs such as breakage of yarns, etc.;

3. To produce a merchandise more uniform in the same piece and securing greater uniformity for the same fabric woven at different times;

4. To increase production by establishing better conditions for the workers by reducing the dry bulb and therewith the effective temperature;

5. To establish better sanitary conditions by eliminating the greatest possible amount of lint suspended in the air; and

6. Greater safety against fire by eliminating most of the lint from the air and by moistening the rest

of it, and by reducing the potential of the static electricity of the air. Dry air is an excellent insulator and, therefore, the friction of machines may build up a high potential of static electricity, with consequent fire hazard. Moist air, being a much better conductor, helps to discharge the static electricity, thus avoiding the dangerous high potentials.

Of all these requirements the various direct moistening systems can accomplish only conditions (1), (2), and partly conditions (3) and (6). Fulfillment of condition (3) is only partial because the uniformity of merchandise produced at different times requires also that the temperature of the air should not vary greatly. Condition (6) is only partly accomplished by direct moistening in reducing the static electricity, but without ventilation the dust and lint and its consequent fire hazard is only partly reduced.

An air conditioning installation, complete with mechanical refrigerating equipment, would be able to maintain inside conditions, dry bulb temperature, as well as relative humidity, between fixed limits, independently of all other circumstances, such as outside conditions, inside heat load produced by the machinery, etc. However, such equipment for the larger size textile mills would have a very high installation cost, and high operating and maintenance cost, not always justified.

Experience has proved that evaporative cooling, when establishing the relative humidities required by textile processes is able to lower the dry bulb temperature sufficiently for producing adequate comfort conditions for workers. This applies especially for conditions when the inside relative humidity to be maintained is about 65-70%. Under these conditions the dry bulb temperature will be 8-10F lower than outside dry bulb temperature, provided that outside conditions are near to 95F dry bulb temperature and 40% r.h., corresponding to 75F wet bulb temperature. The reduction expressed in effective temperature under the conditions stated in the foregoing is about 2-3F below the outside and somewhat more considering the slight and agreeable breeze created. The reduction in the effective temperature may not be very much as compared to that outside, but it is considerable as compared to conditions which would prevail in the workroom without any humidification or even with direct moistening equipment. From the comfort point of view, conditions in a room with direct humidifying may frequently prove worse than without any humidifying at all, due to high humidities established without any considerable reduction of the dry bulb temperature, because of the lack of effective ventilation. It is not uncommon in textile mills without humidifying equipment or with direct sprays to find inside temperatures in summer 10-15F higher than outside temperatures.

The evaporative cooling system operates with 100% outside air in summer, because as the process does not provide any reduction in the wet bulb temperature, in consequence of the inside sensible heat load the inside wet bulb temperature is always higher than outside wet bulb temperature. Total or partial recirculation of the air, therefore, would always result in a more elevated inside wet bulb temperature and, consequently, as the relative humidity has always to be maintained at the same level, in a higher inside dry bulb temperature, too.

In winter two different cases may arise:

1. The inside heat gain produced by the machinery is high enough to compensate the transmission heat loss and the heat required to warm up the outside air, considering that only a part of the air will be taken from outside, the quantity being determined by ventilating requirements. In this case there is no real need to preheat the air before humidifying, because after some time the internal heat gain will heat up the air enough to reach the required conditions; or

2. The internal heat produced is less than the sum of heat required to compensate the transmission loss and to warm up the fresh air. In this case it is absolutely necessary to add heat to the air, whether in the form of preheating or a combination of preheating and reheating. It is always necessary to preheat the air before humidifying to increase the moisture absorbing capacity of the fresh and recirculated air mixture.

In the Argentine climate, case 1 is the most frequent. However, preheaters are often provided to shorten the warm-up period or to produce higher temperatures. Once the stationary conditions are reached the heaters operate with reduced capacity only or even may be cut off entirely. Heaters can also be of advantage on days when the relative humidity surpasses optimum working conditions and, therefore, should be reduced, reheating being the only way to reduce the relative humidity with this kind of equipment. Between seasons there are always periods when the outside relative humidity is extremely high and has to be reduced, especially

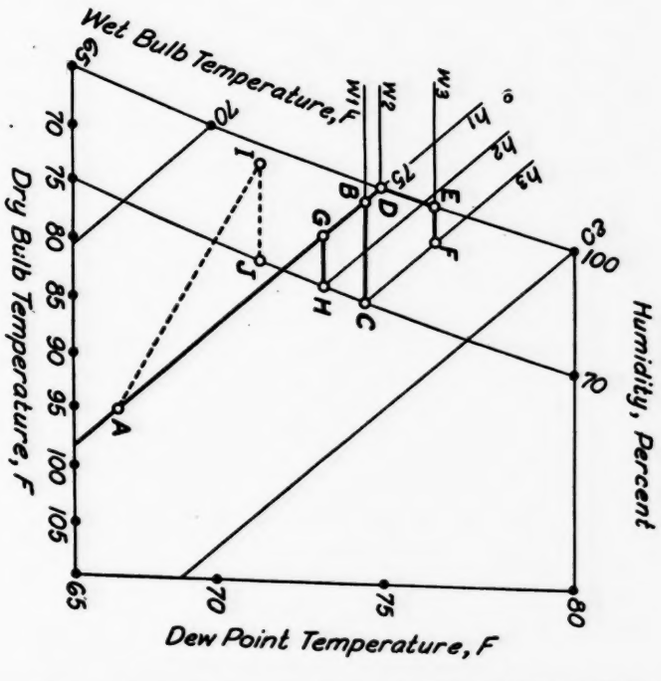


Fig. 1. Section of psychrometric chart showing the evaporative cooling process.

in rooms where the interior sensible heat gain is relatively low. On the whole it may be stated that it is very useful to provide means for heating with this kind of installation.

As mentioned, limitations in the application of the evaporative cooling process for humidifying exist principally because it is difficult to establish very high relative humidities due to the great quantity of air which would have to be injected into the room. To reduce the amount of air which would be needed to establish such high relative humidity, the injected air is in some cases supersaturated, i.e., besides being saturated it carries suspended water drops which evaporate, transforming part of the internal sensible heat gain into latent heat gain. Unfortunately, it is difficult to vaporize the suspended water drops quickly enough, which may sometimes cause rain, a disadvantage which was one of the principal objections against direct water spraying systems. To avoid the rain and to give the suspended water drops time enough to pick up heat and evaporate, long ducts are placed in the room, through which the air has to flow before being injected into the room air. These ducts are a definite disadvantage of this system. In spite of this, systems supplying supersaturated air are used when very high relative humidities are needed, because ordinary evaporative cooling systems, where the air leaves the apparatus only saturated or not even completely saturated are not able to produce very high humidities.

However, most processes in textile manufacture do not need humidities so high that they could not be reached with evaporative cooling. As for the temperature, limitations of this for best processing conditions establish only a minimum of the temperature to be reached, which easily may be performed in winter by providing a heater for the equipment. As for summer, the inside temperatures will always be above the minimum required, and, therefore, the reduction of the temperature serves exclusively a comfort purpose, and this can be accomplished well enough by sensible cooling which the evaporative cooling process is able to produce.

Cotton and Rayon Largest Users

Table 1 gives a comparison of the Argentine practice with European and North American data for optimum working conditions. The difference in the conditions applying to wool is evident. The wool industry in the Argentine uses higher humidities than are used in the U. S., and evaporative cooling is not yet popular in this industry. On the other hand, conditions for the working of cotton are in the best range for evaporative cooling, needing relative humidities mostly between 60 and 70%, which can be easily established with this system, without circulating extremely high quantities of air, and where the reduction of the dry bulb temperature is still high enough to improve comfort considerably. Consequently nearly all installations using this principle are to be found in the cotton industry, although there is also a rayon weaving

Fig. 2. Cotton weaving shop where evaporative cooling equipment is placed on platforms on both ends of two adjoining rooms.

mill in Buenos Aires where evaporative cooling is installed.

Fig. 1 shows the evaporative cooling process on the psychrometric chart. Outside air in a condition marked *A* is taken into the apparatus and humidified to condition *B* for injection to the room, where it will warm up to condition *C*. The humidifying is practically an adiabatic process with no addition or absorption of heat from and to the outside of the apparatus. As the latent heat in the room is negligible in quantity, and because it is only of advantage, it is not taken into consideration.

The course of the supersaturated process is indicated through line *ADEF*. The diagram is prepared in such a manner that points *C* and *F* are on the same wet bulb line, having, therefore, the same total heat content. Thus it can be appreciated that in a room with a specific internal sensible heat load and using exactly the same quantity of air, when this is supersaturated, room conditions will be *F*, corresponding to 79F and 90% relative humidity, whereas with the normal process the room conditions would correspond to *C* with 85F and 70% relative humidity. To accomplish the supersaturated process, every pound of air has to carry in suspension the surplus of the specific humidity w_2-w_1 and this is the difficulty; but in spite of the inconveniences this is the only way to reach extra high humidities with evaporative cooling. As very high humidities are not so frequently needed, it was more important to develop a simple system for general purposes.

There has been developed a construction in evaporative cooling equipment for the textile industry which already may be considered as fairly standard equipment. It is of the so-called panel humidifier type, taking into consideration the special conditions and needs of this industry.

First of all, wherever possible ducts, especially horizontal ones, have been carefully avoided, because these are depositories of dust and lint and are difficult to clean. Besides, ducts do not harmonize esthetically with the inside of the shops and

may often greatly reduce visibility. Last, but not least, in view of the great quantities of air to be moved, these ducts are often expensive. Thus the trend is not to use a single central fan to distribute the air throughout the room, but a number of conveniently sized fans to operate as independent units to inject the air directly into the room, without any ducts if possible. In doing so, great care must be taken to avoid excessive drafts near the injection grilles. This can be avoided by the selection of directional grilles with individually regulable vanes to accomplish a long throw without high air velocities near the grilles. Fewer grilles of large capacity are used rather than a greater number of conventional sizes. As one fan generally feeds several grilles through a plenum or a very short and often rather shapeless duct, it is important to secure uniform distribution of air between the grilles.

Fig. 2 shows a cotton weaving shop where the evaporative cooling equipment has been placed above platforms on both ends of two adjoining rooms. Fig. 3 indicates a spinning mill with similar evaporative cooling equipment which has been located in several basement chambers, each for one group of units. The apparatus used in both cases and in many others is nearly the same.

In summer all air is taken from outside through a set of fixed protection intake grilles covered with a wire net and through another set of regulable dampers. Air then passes through the panel-type humidifier of extended surface, to be filtered, washed and humidified at the same time. The centrifugal fans of large capacity force the moist and cool air directly into the space to be humidified.

In winter only part of the air is taken from outside, most of it will be return air from inside. The return air grilles should be placed as far as possible from the injection grilles as the design may permit, or if not possible, they can be placed below the injection grilles, but at the lowest level possible. As the injection grilles are always placed on highest level and the entering air has a fairly high velocity because of the large throw, there is little danger of a short-circuit in the air-flow.

In most cases, because of the heavy concentration of lint and dust, return air should be prefiltered before entering the mixing chamber through the return dampers, to be mixed with the outside air. Filters are mostly of the cleanable metallic panel type, but automatic self-cleaning filter banks of the oil-immersion type are also used.

Mixing of the outside and return air can be accomplished with damper motors by return air or room thermostats. When starting service with low inside temperature to reach a rapid warming-up, only little outside air is used, or even all air will be recirculated. As the temperature is raised the return dampers are partially closed and the outside dampers gradually open.

From the mixing chamber air passes the extended surface heater and its by-pass, to be preheated before reaching the humidifier, from where, in the same way as in summer, fans force the conditioned air into the room. The heater is automatically controlled by a motorized steam valve and its corresponding thermostat, both of the modulating type. As in this case the temperature of the return air is not always the same as the average room temperature, room thermostats are preferred and should be placed near the humidistat, so that humidity and temperature should be controlled jointly.

Water to the humidifier is supplied by a recirculating pump, controlled by the humidistat in such a way that when the maximum desired retative humidity is reached the humidistat, acting on the automatic starter, stops the pump. As generally a pump supplies a unit consisting of more than one fan, it is convenient to arrange a combination in the wiring so that when the pump stops some of the fans should also stop. In this way, as the necessary relative humidity is reached, advantage can be taken of the delaying action of the humidifying panels in losing the moisture, and there will be no sudden change of humidity in the room.

Regulation of the system's capacity consists mostly in stopping one or more fans as the heat load decreases. Since every installation consists of a number of conveniently sized fans, this is a simple and most economical form of regulating the system's output.

Another possibility of regulation lies in changing the state of the air to be injected. Referring to the psychrometric diagram, Fig. 1, it may be seen that, operating always with the same quantity of air, when the sensible heat load decreases to 50% of the process indicated by *ABC*, the line of the process will change to *AGH*. To condition the air to point *G*, part of it should be by-passed around the humidifier. The room condition corresponding to point *H* will be of somewhat lower dry bulb temperature, but this is not enough advantage to justify the higher operating costs caused by the continuous service of all fans.

In every installation executed up to now the water has been recirculated with a very small consump-

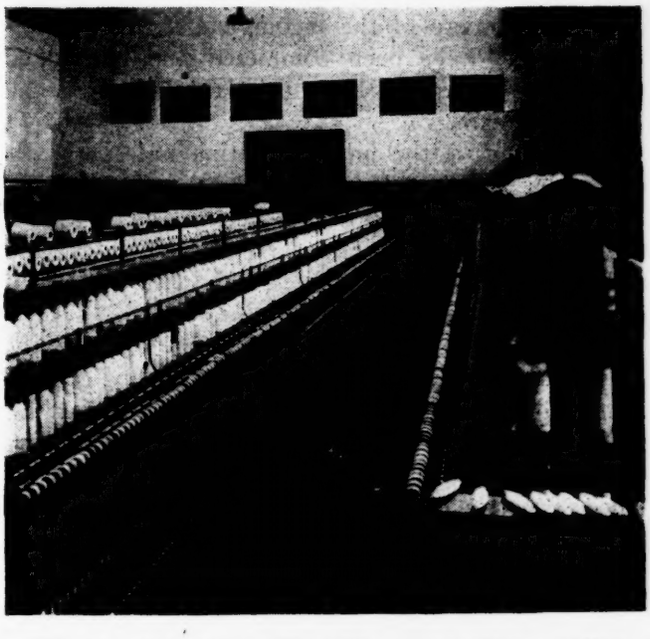


Fig. 3. Spinning mill with evaporative cooling equipment located in weaving basement, each for one group of units.

tion of make-up water to compensate for evaporation. In this way very large equipments may be fed with city water, changing the whole amount weekly, in most cases because of the dirt accumulated in the water.

There would not be any real advantage in using well water for further reduction of the dry and wet bulb temperatures of the air. The design wet bulb temperature which will be equilibrium temperature of the constantly recirculated water as previously stated is 75F, and the summer temperature of well water in Buenos Aires is about 66F. Consequently, there would not be an appreciable difference, except when supplying a fair amount of well water, and even then the difference would hardly be more than 2-3F. The course of the process using well water is shown on the psychrometric chart by dotted line *AIJ*. On the other hand, this great amount of water would cause much drainage trouble, since, because of its dirtiness, it could not be used any more for other purposes. Moreover, the pumping costs would become an important factor, while these are negligible when recirculating the water, not to mention the initial costs represented by a well and a well pump. The only precaution to be taken when recirculating the water consists in placing a filter of ample surface in the suction line of the pump and providing means for its easy cleaning.

In conclusion, evaporative cooling equipment includes only simple machinery, and in consequence maintenance costs are reduced to a minimum. No specially trained personnel is needed for maintenance; low installed horsepower is an advantage, as is the low power consumption. Based on all of these foregoing statements it does not seem too optimistic to predict a great demand in the near future for evaporative cooling for the textile industry and similar purposes.

The Final Inspection

THE contractor has reported that his work is completed and that he has taken care of the various incidental items which have been brought to his attention as deficiencies. It is now time for the final inspection.

The question is, "What is the purpose of this final inspection and how should it be made?"

To some—perhaps many—that will seem a foolish inquiry, but perhaps it is not so foolish as the way in which many final inspections are made.

Apparatus, materials and workmanship have been carefully checked as the work progressed and their sizes, capacities, makes and characteristics verified and approved and the errors corrected. As the time of completion approached, "deficiency lists" have been made and copies of them turned over to the contractor; many of the incomplete items enumerated therein have been completed and eliminated from the subsequent lists until a relatively small number remain.

Why, then, is the final inspection necessary? Is it merely a matter of routine so that the superintendent can report that it has been made, or is it a case of taking the plans and specifications and "going over them with a fine tooth comb" to see if something else has so far escaped notice?

As a matter of fact, it is neither the one nor the other. If the superintendent is thoroughly conversant with the plans and specifications; if he is familar with the little individual preferences and idiosyncrasies which earmark the work turned out by the office ("personal characteristics," one might call them) and if he has conscientiously and consistently followed the work through, up to that time; assuming that he is competent to handle the project, the final inspection is not routine, by any means; neither is it complicated.

Plans and specifications can be laid aside; the superintendent is satisfied that their intent and the detailed requirements, except for those noted on the deficiency list, have been complied with. All he needs now, is the latest deficiency list.

That does not mean, however, that all that remains to be done is to check that list against the installation; in fact that, in one sense, although necessary, is the minor part of the work. What actually is required now, in addition to checking the list against the installation, is that the superintendent should endeavor to "stand off" from the work and gain an over-all view of the project to see whether or not the installation looks as if it was meant to be just the way it is and, if it does not, to find out why, and to have the condition remedied.

If the work looks as though each part of it belonged exactly where it is, much can (and will) be forgiven, so to speak; but if it does not, it will be an everlasting eyesore and a source of dissatisfaction to all concerned for, it should be recognized, most laymen can spot an incongruity almost instinctively and whatever happens—no matter what the actual cause may be — any trouble will undoubtedly, sooner rather than later, be associated with the sore spot and no amount of argument and logic will suffice to overcome that idea.

Naturally, in order to *be* right, the installation must function properly; but if it does not *look* right, it is highly probable that, regardless of how well it operates, it will never *seem* right.

In plain English, the final inspection is the superintendent's last opportunity to accomplish what may actually prove to be the most important part of the entire work—to arrange the psychological atmosphere which will create in the owner's mind the impression that he is—or is not—getting a first class piece of work. — *John J. Woolfenden, Engineering Staff, Smith, Hinchman & Grylls, Inc., Detroit.*

Ventilation Requirements for Industrial Solvents – Part 1:

Dilution Rates of Vapor

New and fundamental material for direct application to ventilation design problems is presented in Mr. Hemeon's series of four articles of which this is the first. These articles present data of a handbook nature that will enable elimination of rule-of-thumb methods.

W. C. L. HEMEON
Industrial Hygiene Foundation
Mellon Institute, Pittsburgh, Pa.

SINCE our first description of the dilution process as applied to industrial ventilation[1] we have had considerable experience with it and wish now to set forth a more complete theory and basis for the design of ventilation to control solvent vapors. While the fundamental principles relate to ventilation for all types of contaminants, they are more completely applicable in practice to solvent vapors, and our treatment in this paper will therefore be limited to this class.

In the prior series of articles, we showed the fallacy in certain commonly held views, including the idea that solvent vapors are materially heavier than air and that this property can be utilized in the design of ventilation. We also discussed the idea often used as a basis for ventilation calculations that ventilation requirements can be presented in terms of "number of air changes per hour," and demonstrated it to be meaningless and therefore without value in this connection.

We shall present the fundamental principles and design data in the present article. In later articles methods for calculating distribution will be given for various industrial circumstances together with actual design problems.

The ventilation principle for solvents is based on the fact that volumes of vapors formed for given amounts of liquid solvent can easily be calculated and can be combined by simple arithmetic with figures for desired maximum concentrations in air to give air volume needed for dilution to any desired value.

Example

As an example let us assume a solvent is evaporated at a rate to give 0.1 cubic foot of solvent vapor per minute (0.1 cfm) and its concentration (m.a.c.) in the general atmosphere must not exceed 100 ppm (0.01%). What rate of general ventilation would be required?

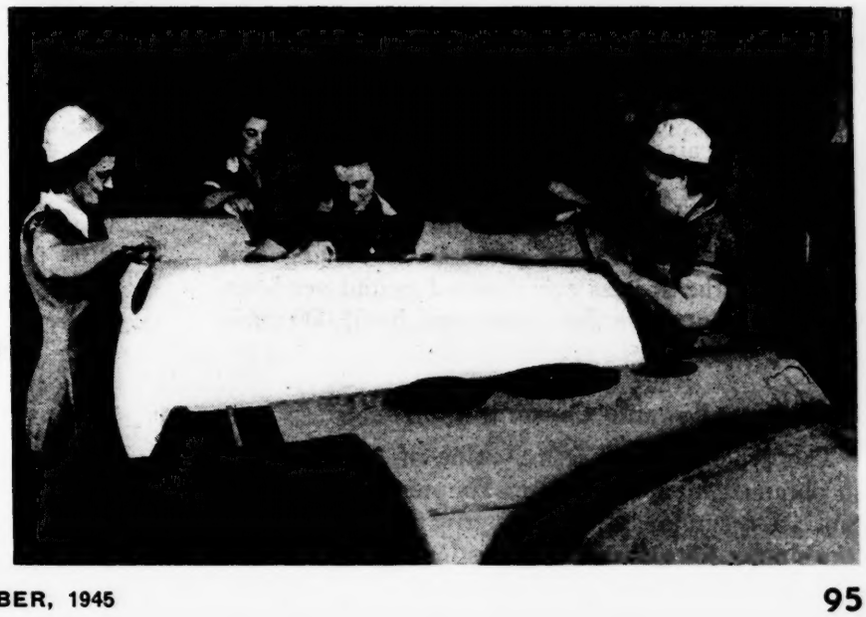
$$\textit{Solution:}\quad \frac{100}{1{,}000{,}000} = \frac{1 \text{ part vapor}}{10{,}000 \text{ pts. of air}}$$

$$0.1 \text{ cfm} \times 10{,}000 = 1000 \text{ cfm.}$$

The volume of solvent vapor formed may be calculated by the following formula:

$$\text{cfm (vapor)} = \frac{\text{lbs. liquid solvent}}{\text{minute}} \times \frac{400}{\text{molecular wt.}}$$

[1]Hemeon, W. C. L. "Air Dilution in Industrial Ventilation." HEATING AND VENTILATING, November, December, 1940; February, March, 1941.



Manufacture of puncture-proof tanks includes handling many volatile solvents and laminating compounds. Ventilation must be adequate.

TABLE 1.—MAXIMUM ALLOWABLE CONCENTRATIONS COMMONLY ACCEPTED FOR THE GROUP OF TOXIC SOLVENT VAPORS

SOLVENT	M.A.C.
Benzol	100 ppm
Carbon disulfide	15
Carbon tetrachloride	100
Dichlorbenzene	75
Dichlorethyl ether	15
Ethylene dichloride	100
Methanol	200
Methyl cellosolve	25
Monochlorbenzene	75
Tetrachlorethane	10
Tetrachlorethylene	200*
Trichlorethylene	200*
Toluene	200*

*There is considerable evidence that these solvents do not have positively toxic effects until concentrations several-fold those indicated are reached. Their irritating or narcotic effects at 200 ppm are such that they might with justice have been placed in the group of Table 2.

The figure 400 is the pound-molecular weight in *round numbers* at room temperature.

From this information and a specification as to the maximum allowable concentration, the ventilation rate for a given solvent is calculated as follows:

$$\text{cfm air required} = \frac{\text{cfm vapor} \times 10^6}{\text{m.a.c.}}$$

The two combined give

$$\text{cfm air required} = \frac{\text{(lbs. liquid solvent)}}{\text{minute}} \times \frac{400}{\text{m.w.}} \times \frac{10^6}{\text{m.a.c.}}$$

Solvent Dilution Rates

For a given solvent, the molecular weight and allowable concentration may be inserted in the previous equation and the time factor eliminated, to afford a "handbook" value for that particular solvent in terms of cubic feet of air required for "adequate" dilution, per pound of solvent evaporated. It may also be expressed on a pint basis. Adequate dilution is defined in the term "allowable concentration."

If the "maximum allowable concentration" for ethyl acetate is accepted as 75 parts per million, we can compute the *dilution* rate for it as follows (the molecular weight is 88):

$$\text{Cubic feet air/pound} = 1 \times \frac{400}{88} \times \frac{10^6}{75} = 61{,}000$$

We thus obtain a value of use in calculating ventilation requirements for processes involving this solvent. If the process evaporates 1 pound per hour, the fundamental *ventilation* rate will be 61,000 cubic feet per hour.

Maximum Allowable Concentrations

The practical engineering value of dilution rates so obtained hinges on the maximum allowable concentration employed in their derivation. It is therefore appropriate for us to consider the background of such values. It is essential for the designing engineer to have a rational basis for his calculations and to know what he is expected to accomplish and, equally important, the nature of the risks in not attaining exactly the planned result. The intelligent use of safety factors is plainly dependent upon the nature of the risks.

Toxic Solvents

Industrial hygienists are chiefly concerned with the evaluation of potentially toxic conditions and have developed techniques for measuring very small concentrations of vapors in air. The values of maximum permissible concentration for the truly toxic solvents (see Table 1) represent the best information of industrial toxicology. There is a growing tendency to incorporate these limits into rules and regulations of state industrial commissions or labor departments and they may consequently exert an influence in compensation matters. Because of this fact it is generally felt that any value should not be lowered without good evidence that occupational disease may result from exposures near currently accepted limits. Nevertheless, there is evidence of fragmentary character in the case of some of these solvents that effects of acute discomfort, at least, result from exposures considered to be below toxic limits.

Irritating and Narcotic Solvents.

Also usually included in tables of maximum permissible concentrations are those solvents listed in Table 2. Considering chronic exposure, they are not toxic in a practical sense of the word, because their irritating vapors are a compelling incentive to some kind of ventilation, however inadequate by other standards. Ether and naphtha have a narcotic effect that is overwhelming before any toxic effect could be manifest. Practically all the values in this table are far too high to be useful in the design of ventilation systems.

Ventilation-Design-Concentrations

We have selected Ventilation-Design-Concentrations, which we recommend for use in designing ventilation for the common solvents of Tables 1 and 2, as well as a number of others for which toxic limits have not been heretofore proposed. These data are presented in Table 3 together with solvent dilution rates which may be used

TABLE 2.—MAXIMUM ALLOWABLE CONCENTRATIONS COMMONLY ACCEPTED FOR A GROUP OF SOLVENT VAPORS PRIMARILY IRRITATING OR NARCOTIC AT THE CONCENTRATIONS INDICATED

SOLVENT	M.A.C.
Amyl acetate	400 ppm
Butyl acetate	400
Ether (ethyl)	400
Naphtha (gasoline)	1000
Turpentine	200
Xylol	200

TABLE 3.—DILUTION RATES FOR COMMON INDUSTRIAL SOLVENTS RECOMMENDED FOR USE IN VENTILATION DESIGN

	M.W.	S.G.	Vent. Design Conc.	Dilution Rate Cubic Feet of Air		Possible Complaints if Twice Ventilation Design Concentration Exceeded
				per Lb.	per Pint	
Acetone	58	0.79	150	46,000	38,000	Disagreeable
Amyl acetate	130	0.87	75	41,000	37,000	Disagreeable
Amyl alcohol (iso)	88	0.82	50	91,000	78,000	Disagreeable
Benzol	78	0.88	25	206,000	188,000	Toxic
Butyl acetate	116	0.88	75	46,000	42,000	Disagreeable
Butyl alcohol (n.)	74	0.81	25	216,000	182,000	Disagreeable
Butyl cellosolve	118	0.90	25	136,000	127,000	Toxic
Butyl ether	130	0.77	25	123,000	98,000	Disagreeable
Carbon disulfide	76	1.26	7	750,000	980,000	Toxic
Carbon tetrachloride	154	1.58	25	104,000	171,000	Disagreeable-toxic
Cellosolve	90	0.93	50	89,000	86,000	Toxic
Cellosolve acetate	132	0.97	50	61,000	61,000	Toxic
Chloroform	119	1.50	25	135,000	210,000	Disagreeable-toxic
Cyclohexanol	100	0.96	50	80,000	80,000	Disagreeable
Cyclohexanone	98	0.95	25	163,000	161,000	Disagreeable
Dichlorbenzene (ortho)	147	1.32	50	54,000	74,000	Toxic
Dichlorethylene	97	1.25	75	55,000	72,000	Disagreeable-toxic
Dichlorethyl ether	143	1.22	10	280,000	360,000	Toxic
Dichlormethane	85	1.33	200	24,000	33,000	Disagreeable-toxic
Dioxane	88	1.04	25	182,000	197,000	Toxic
Ether (ethyl)	74	0.72	75	72,000	54,000	Disagreeable
Ethyl acetate	88	0.90	75	61,000	57,000	Disagreeable
Ethyl alcohol	46	0.79	250	34,000	28,000	Disagreeable
Ethylene dichloride	99	1.25	25	161,000	210,000	Disagreeable-toxic
Isophorone	138	0.92	10	290,000	277,000	Disagreeable-toxic
Isopropyl acetate	102	0.87	75	52,000	47,000	Disagreeable
Isopropyl alcohol	60	0.79	150	45,000	37,000	Disagreeable
Isopropyl ether	102	0.72	50	78,000	58,000	Disagreeable
Mesityl oxide	98	0.86	10	410,000	370,000	Disagreeable-toxic
Methanol	32	0.80	100	125,000	103,000	Toxic
Methyl acetate	74	0.96	75	72,000	72,000	Disagreeable
Methyl amyl acetate	144	0.86	75	37,000	33,000	Disagreeable
Methyl amyl alcohol	102	0.81	25	157,000	133,000	Disagreeable
Methyl cellosolve	76	0.97	25	210,000	210,000	Toxic
Methyl chloride	51	0.92	200	39,000	37,000	Toxic
Methyl-ethyl ketone	72	0.81	150	37,000	31,000	Disagreeable
Methyl isobutyl ketone	100	0.80	150	27,000	22,000	Disagreeable
Monochlorbenzene	113	1.11	50	71,000	82,000	Toxic
Nitro ethane	75	1.05	50	107,000	117,000	Toxic
Nitro methane	61	1.14	50	131,000	155,000	Toxic
Pentachlorethane	202	1.67	2	1,000,000	1,740,000	Toxic
Petroleum ether	72	0.63	500	11,000	7,000	Disagreeable
P.M.V. naphtha	110	0.75	200	18,000	14,000	Disagreeable-toxic
Propyl acetate	102	0.89	75	52,000	48,000	Disagreeable
Solvesso	125	0.80	200	16,000	13,000	Disagreeable-toxic
Stoddard solvent	130	0.80	500	6,000	5,000	Disagreeable
Tetrachlorethane	168	1.58	5	480,000	790,000	Toxic
Tetrachlorethylene	166	1.62	100	24,000	40,000	Disagreeable-toxic
Toluol	92	0.87	100	44,000	39,000	Toxic
Trichlorethane	133	1.44	100	30,000	45,000	Disagreeable-toxic
Trichlorethylene	131	1.46	100	30,000	45,000	Disagreeable-toxic
Turpentine	136	0.87	75	39,000	35,000	Disagreeable
Xylol	106	0.88	75	50,000	46,000	Disagreeable

N.B.—The "Ventilation Design Concentrations" in the table are not to be identified with values of maximum allowable concentrations employed in appraising working conditions since all V.D.C.'s include a factor of safety.

directly in ventilation problems. Their application will be illustrated in later problems.

The Ventilation-Design-Concentrations for the toxic solvents have been based largely on the limits of Table 1, except that we have incorporated safety factors of varying proportions depending on our judgment of the risks.

As to other solvents we have been guided in part by the work of Nelson, Ege and others[2] who reported subjective reactions to concentrations of several common solvents. Their work was largely intended to provide data for the application of the method being described. It consisted simply in obtaining opinions from 10 or 12 subjects of a series of vapor atmospheres to which they were exposed for 5 minutes.

It is recognized that one may become inured to the unpleasant effects of many vapors after several hours' exposure. But concentrations voted tolerable in a short-time period before olfactory fatigue occurs are of more value in solving our problem because we desire the ventilation to result in acceptable reactions by visitors from outside the ventilated department as well as by the working occupants.

The efforts of the designing engineer are directed not only to the prevention of poisoning but to the production and maintenance of an atmosphere that will be tolerable and acceptable to the great majority of working people. The result must be satisfactory from the standpoint of smell and must be safe by toxicological standards in the case of those vapors

[2]Sensory Response to Certain Industrial Solvent Vapors. K. W. Nelson, J. F. Ege, Jr., M. Ross, L. E. Woodman and L. Silverman. J. Ind. Hyg. and Tox., *25*, 282-285 (Sept., 1943).

that are not unpleasant in the dangerous concentrations. In a word, the result must be satisfactory to the workers and to the physician in order to be satisfactory to the management.

The limits of Table 3 on which the solvent dilution rates are based are not to be identified with maximum allowable concentrations appearing in formal industrial hygiene tables. Some of the values we recommend are based on experiences that lack scientific completeness from an investigational standpoint; others, more particularly those of primarily irritating properties, have been based partly on the findings of Nelson and co-workers, partly on field experiences, and partly on inferences. They are subject to change with passage of time, but they are practical values and are believed to be on the safe side from the engineering standpoint.

The last column in Table 3 provides a guide to the nature of the risk in the event that concentrations exceed the value planned owing to some factor not foreseen when the system was designed. This information will enable an appraisal of the safety factors to be applied by the designer and will furnish a basis for balancing economic factors under unusual or difficult conditions. Complaints of unsatisfactory ventilation may come from workers, from a state agency, or from the plant physician or industrial hygienist.

"Disagreeable" means that, at the double concentration, the vapor concentration is still below the maximum allowable required by any state, although quite likely to be objectionable.

"Toxic" signifies that the double concentration equals or exceeds listed maximum allowable concentrations, or that the vapor is considered unsafe by some authorities at those concentrations.

"Disagreeable-toxic" indicates that at concentrations greater than twice the V.D.C. the atmosphere is primarily disagreeable, but the vapor is also considered toxic at concentrations only moderately greater.

Conclusion

We have presented design data addressed solely to the ventilation engineer indicating recommended rates of ventilation for various industrial solvents. While the "Ventilation Design Concentrations" given do in some cases bear a relation to the accepted toxic limit this is just as often not true and any identification of these figures with "Maximum Allowable Concentrations" is totally unwarranted. Safety factors of varying degrees have been incorporated in the recommended values solely in the interest of the designing engineer, to insure that the result of his efforts will be free of criticism or dissatisfaction from any quarter.

Forced Air Dries Hay

Where climatic conditions introduce an element of uncertainty into the field-drying of hay and alfalfa, increasing attention is being given to drying these crops in the hay mow by forced air ventilation. The following observatinns are made by A. T. Hendrix, reporting in the September issue of *Agricultural Engineering* of work of the Bureau of Plant Industry in cooperation with the Virginia Agricultural Experiment Station. Mr Hendrix is associate agricultural engineer with the U. S. D. A. Bureau of Plant Industry.

The resistance of hay to air flow, according to Mr. Hendrix, is one of the more important factors requiring additional data to facilitate design of hay drying systems. To study the problem, an experimental installation was set up at the Virginia station. This was done because of the difficulty in making accurate measurements directly on the usual barn installation.

Tests were run on a hay mow 10 ft square and 12 ft high with a slatted floor under which was a plenum chamber 10 ft square by 3 ft deep. A centrifugal blower introduced air at controlled velocities into the chamber; and instruments for measuring temperature, pressure, moistue content ,etc., were spaced to control the experiment accurately.

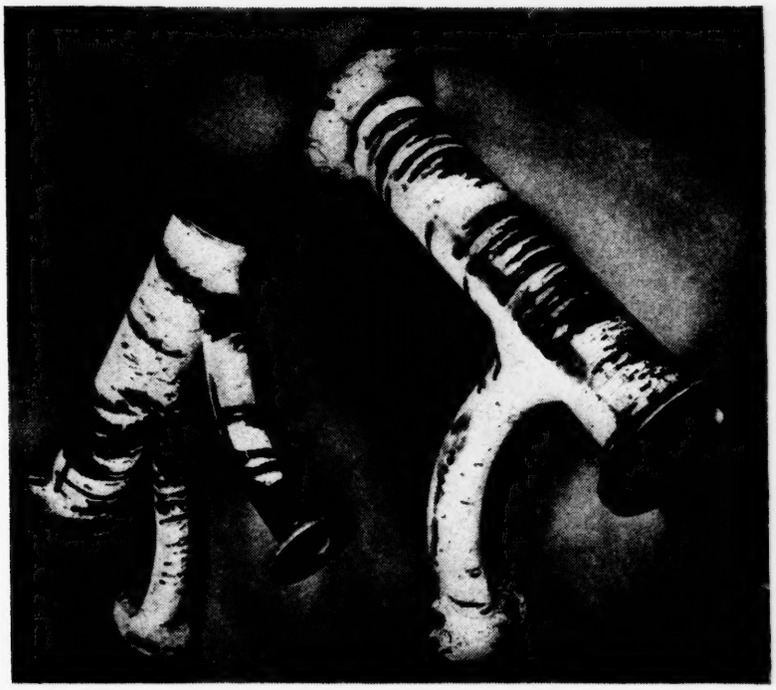
Alfalfa hay of 51% moisture content was placed in the mow. The mow was filled to a depth of 12 ft (5650 lb of hay) within a period of five hours. The fan was operated to supply about 20 cfm per sq ft of mow floor continuously except for an "off" period of 4 hr from 5 a.m. to 9 a.m. daily. During the drying period, mean relative humidity of the air was 76%. Twelve days were required to reduce the moisture content of the hay to a safe storage content o fthe hay to a safe nart2aE890$....$.... content of 20%.

Results of the test show that for a given static pressure, the air flow is reduced by about one-half for each 3-ft increase in depth above 6 ft. Also, the static pressure required to effect a given volume of air flow is more than doubled for each 3-ft increase in depth above 6 ft. To effect a given equal rate of hay drying, the volume of air supplied must be increased at a greater rate than increase in depth.

As drying proceeds, resistance to air flow decreases as does the depth of the hay. The final depth of hay in this mow was about 8½ ft and air flow at a given pressure increased 2 or 3 cfm per sq ft of floor.

Care should be taken in distributing hay in the mow so that the air will pass through the mass of hay rather than escaping through loosely piled edges. Additional layers placed on top of hay that is already dried should be less thick as total depth of hay increases.

Pipe With Rubber Lining



Pipes used to carry caustic in paper mill show variety of shapes and sizes that can be lined with rubber for special service lines.

RUBBER lined pipe has been used successfully in industrial plants to carry solutions and material that may react with metal. It is used by the paper and pulp industry, electroplating, steel, and in chemical process fields.

Rubber lined pipe is not a standard item. Special sections must be fabricated to order and these, together with the necessary fittings, sent to a rubber company for lining. An alternative procedure is to have the rubber company purchase the pipe and fittings, and install the linings.

It is possible to rubber line pipe in sizes from 1½ to 84 in. For ordinary service, the lining is ⅛ in. thick but where there may be some abrasive action or where the lining will be given severe service, the thickness is 3/16 or even ¼ in. Several types of synthetic or natural rubber are available and a rubber can be compounded to meet special conditions.

Steel pipe is ordinarily used. For tees, elbows and other fittings, 125 lb cast iron fittings are used. Elbows can be provided with added rubber thickness at the bend where wear will be greatest.

Pipe for a specific line must be prefabricated to exact measurements. The first step is to lay out the line on a drafting board, and from that determine the number of standard and special lengths required. The tolerance from center to face, or from face to face, is from 0 in. to —⅛ in., and this is compensated for by the gasket material between flanges.

Where flanges are screwed on to the pipe A.S.M.E.

A layer of rubber 3/16 in. thick is stretched over large pipe for carrying distilled water.

Abstracts AND Reviews

INDUSTRIAL PROCESS CONTROL

The science of instrumentation and automatic control has seen great progress during recent years. There is scarcely an industrial process that does not have automatic control for producing products of uniform quality, for improving quality, or for the reduction of costs.

The theory of automatic control is presented in a concise manner and is understandable without the knowledge of advanced mathematics. The book presents data on the measuring characteristics of controllers, the effect of process load changes, the effect of valve characteristics, and correlated or multiple control systems.

While intended primarily for the engineering student, it can also serve as a training manual in an industrial plant or as a reference work for the industrial user of automatic control equipment.

Principles of Industrial Process Control by D. P. Eckman. Cloth bound, 5½ x 8½ in., 237 pages. Published by John Wiley & Sons, Inc. Price, $3.50.

EFFICIENT USE OF FUEL

In the American edition of The Efficient Use of Fuel, a book prepared under the direction of the Education Sub-Committee of the Fuel Efficiency Committee of the Ministry of Fuel and Power, England, is presented many phases of the fuel subject. The treatment of fuel from the British point of view will not be detrimental to the American reader and may tend to broaden the perspective.

The book has chapters on coal, chemical principles of combustion and gasification, combustion in practice, steam, heat transmission, flow of fluids, boiler operation, pulverized fuel, boiler feed water purification, boiler testing, gas producers, furnaces, waste heat boilers, electric furnaces, refractory and insulating materials, steam for industrial processes, central heating, drying, oil and its utilization, graphical heat balances, instruments, sampling of gases, and solid fuel analysis.

Here is an illustrated text book for those wanting an all-embracing volume on fuel.

The Efficient Use of Fuel. Cloth Bound, 5½ x 8½ in., 807 pages. Published by Chemical Publishing Co., Inc. Price, $8.50.

ARC WELDING

Courses in the fundamentals of arc welding, and also in alloy welding, sheet metal welding and pipe welding are given in the Lincoln Arc Welding School. This instruction has been grouped into a series of 61 lessons of which the first 36 lessons constitute the basic course, and the balance the advanced instruction. These lessons with illustrations are now available as the second edition of Lessons in Arc Welding.

Lessons in Arc Welding. Cloth bound, 5½ x 8½ in., 176 pages. Published by The Lincoln Electric Co. Price, 50 cents.

IN BRIEF

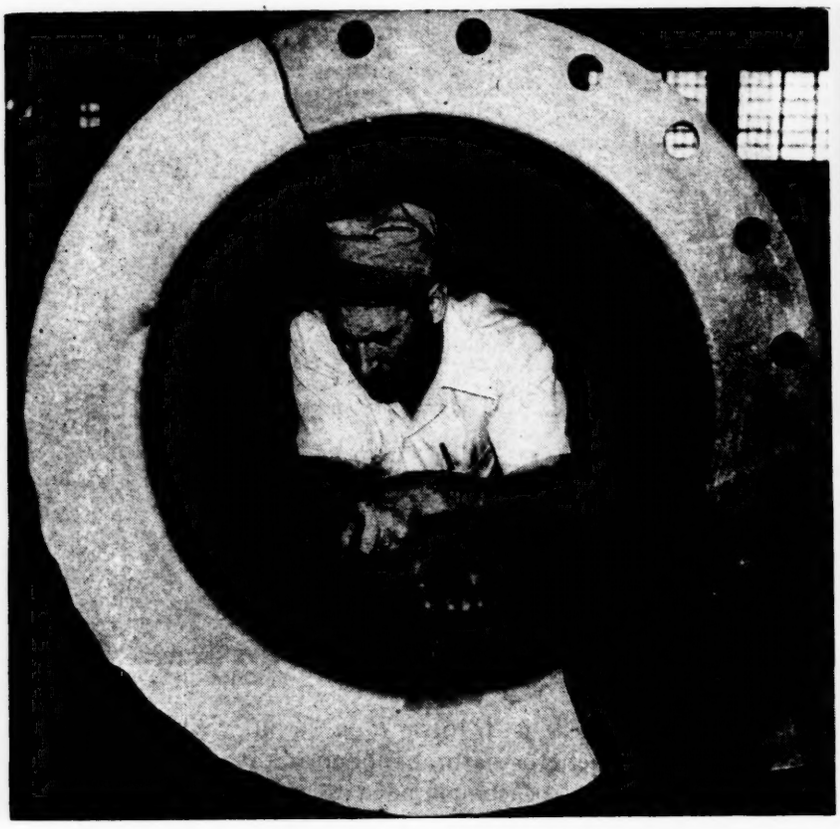
TWO AIDS FOR VETERANS.—The Air Conditioning and Refrigerating Machinery Association, Southern Building, Washington 5, D. C., has published a 12-page booklet under the title, "Job Opportunities for the War Veteran in the Air Conditioning and Refrigeration Industry." This booklet, distributed free by the association, describes the industry as a whole and shows the opportunities and types of jobs involved in its various branches. A section is devoted to training and a partial list of schools giving courses in the field in various states is presented.

Somewhat more detailed regarding technical aspects of the business and the requirements and procedure necessary in getting into G-E's own particular phases is a 44-page review of "Career Opportunities in the Air Conditioning and Refrigeration Business," published and distributed free by General Electric, Air Conditioning Department, Bloomfield, N. J.

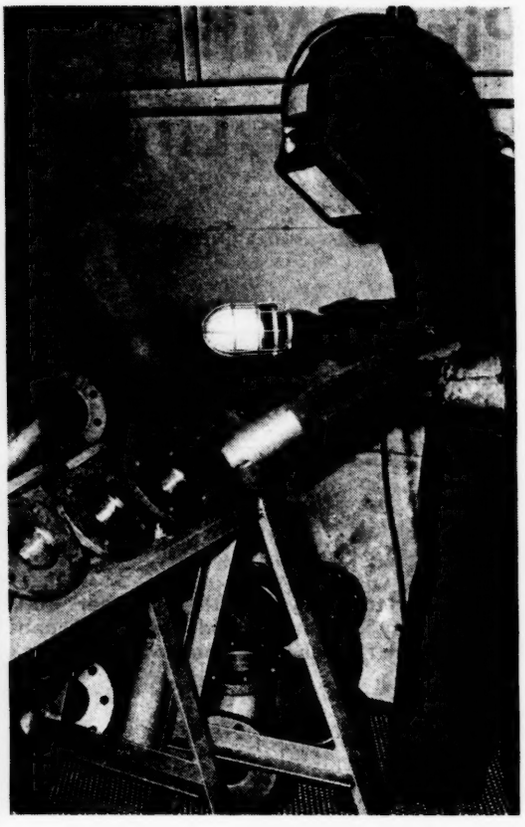
GUIDE FOR HOME PLANNERS.—The family thinking about building or remodeling a home will find "Let's Plan A Peacetime Home," published by Surface Combustion Corp., a book helpful in planning for a home to fit its habits and needs. The authors, all prominent home planning authorities, are Mary Davis Gillies, interior decorating editor of McCall's Magazine; Kenneth K. Stowel and Emerson Goble, editor and managing editor of Architectural Record; and H. V. Walsh, architect, writer and a professor of architecture. In a friendly and understandable way, they discuss every phase of home planning from selecting a site to interior decorating of the completed home. The 114-page book discusses functional planning, how to plan rooms, architectural styles, kitchen planning, arrangements for making household duties simpler, and one of the sections has helpful advice on the business side of building a house. The heating section of the book discusses all popular types of fuels and heating systems, including radiant and solar heating. The new book has a special section on modernizing old homes which shows by plans and photos what has been accomplished by other home owners. This section points out the principal consideration in such an undertaking, structurally and economically. The price of the book is $1.00 and it may be obtained by ordering from Surface Combustion Corp., Toledo 1, Ohio.

GAS SUMMER AIR CONDITIONING.—Technical Advances in Gas Summer Air Conditioning has been released as a 46-page report by the American Gas Association. It contains three articles as follows: Gas Summer Air Conditioning Has Important Post War Possibilities, by John de B. Shepard; Gas Air Conditioning Brought Up To Date—Field Experience With Gas-Operated Installations, by W. F. Friend; and Gas Air Conditioning for Industrial Processing, by Harold S. Birkett. The paper by Mr. Friend was published in the July and August, 1944, issues of HEATING AND VENTILATING. The report contains photographs of typical applications, tables giving temperature range of typical installations of industrial dehydration, and cost data. Available from American Gas Association, 420 Lexington Ave., New York 17, N. Y.

COMMODITY SPECIFICATIONS (National Bureau of Standards Miscellaneous Publication M178).—For determining whether an applicable standard specification exists for any commodity desired, reference should be made to the National Directory of Commodity Specifications. The third, revised, and enlarged edition has been issued. In it are listed by title, designating number, and sponsoring organization, the specifications and methods of test for all commodities regularly produced in this country. Each specification is also briefly summarized as to technical characteristics, scope and special applications. The Directory includes directions for obtaining copies of the documents themselves. Directory is available at $4 from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.



U. S. Rubber's Thomas Dickson is shown inside a pipe being lined with 3/16 in. rubber to protect against corrosion by acid.



Elbows for chemical systems are lined with rubber by the shot blasting method.

125 lb standard cast iron flanges are used. On welded sections, the flanges may be A.S.M.E. 150 lb standard steel slip-on flanges with plain faces. The pipe is finished flush with the face of the flange after assembly. All welds on surfaces to be rubber covered must be ground down to a smooth metal surface, using a No. 24 grain grade Q wheel or finer, and the welds must be free from pits and other imperfections.

Steel pipe should be butt welded for nominal diameters below 3½ in., and for larger sizes must be lap welded and free from deep seams, ridges or other imperfections that would result in a poor base for the lining.

Before the rubber lining can be applied, the pipe must be free from oil, grease, or viscous coating. The metal is sand-blasted, adhesive is applied to the clean metal surface, the rubber sheet fitted into place, and then the pipe length or fitting vulcanized.

Gaskets are used between pipe lengths—a soft rubber gasket for pipe with hard rubber lining, and a non-compressible fibre gasket where the linings are soft rubber.

Where a rubber lined pipe line is installed, rubber lined valves, flow meters and expansion joints are often used.

Following is an approximate summation of the cost of the rubber lining as related to the cost of standard steel pipe:

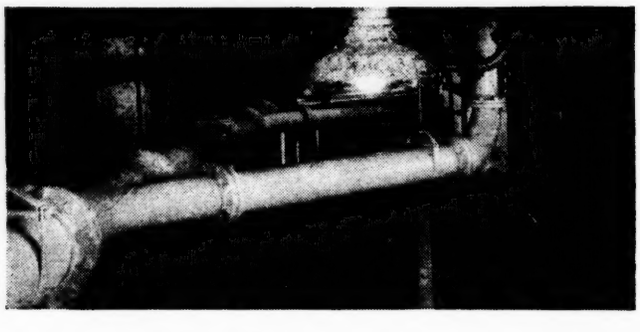
Pipe Size in In.	Lining Cost Times Pipe Cost
1½	5
6	1½
12	1½

The cost of the lining for fittings, as related to the cost of cast iron fittings, follows:

Fitting Size in In.	Lining Cost Times Cost of C.I. Fittings
2	3
4	2
6	1 2/3
10	1

The pressure drop or friction loss for rubber lined pipe is about equal to that of new steel pipe.

Data and illustrations for this article supplied through the courtesy of United States Rubber Co.

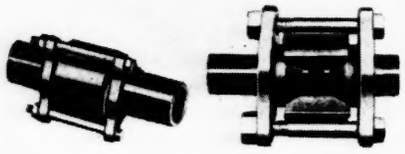


Rubber lined pipes in a paper mill carry bleached pulp. Special formula rubber is used.

NEWS OF EQUIPMENT AND MATERIALS

Pipe Connections

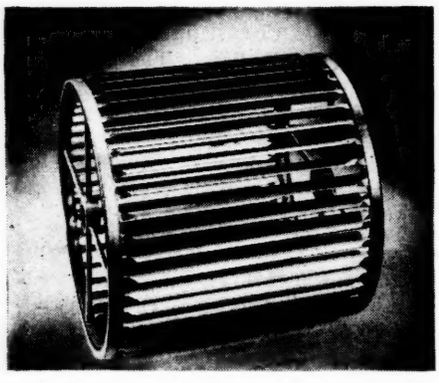
NAME—Karbate pipe connections.
PURPOSE—A line of chemically resistant pipe connections that can be readily installed on the job.
FEATURES—Karbate is a material made from carbon or graphite. The type V flanged connections offer the advantages of the more generally known Van Stone type flanges. The thick, small diameter collars provide a sturdy construction. It can be used with companion flanges of almost



any design or material. Separate cast iron split flanges permit easy pipe alignment and installation. Type FC flexible coupling can be easily installed and dismantled on the job. Pipe may be cut to the required length on the job and rapidly installed without the use of field cemented joints. Line also includes type SC slotted coupler and type V nozzle which are not suitable for field connections.
MADE BY—*National Carbon Co., Inc., 30 East 42nd St., New York 17, N. Y.*

Blower Wheel

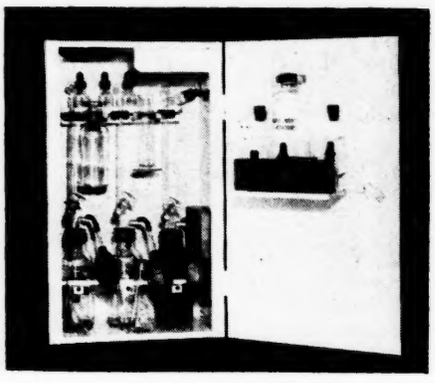
NAME—Mayne centrifugal blower wheel.
PURPOSE—For use with blowers for air conditioning.



FEATURES—The end ring construction of the wheel is said to provide 25% more area for air to enter than the average blower wheel, thereby reducing entrance losses. A hook and lock construction is employed.
SIZES AND CAPACITIES—9 to 16 in. dia.
MADE BY—*Mayne Products Co., 324 Harries Bldg., Dayton 2, Ohio.*

Water Analysis Kit

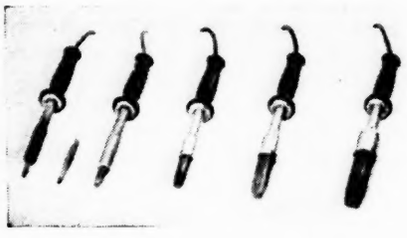
NAME—Testmaster Junior.
PURPOSE—For making the necessary water tests for maintaining the quality of boiler feed water and process water.
FEATURES—It is designed for plants where hardness, alkalinity to P & M, and chloride determinations are adequate for dependable water control. The same cabinet, without modifications, can accommodate a TrueTest phosphate tray, and a pH test unit.



With this set, one can make all normal water control tests with the exception of dissolved oxygen. Unit contains all the necessary reagents.
MADE BY—*TrueTest Laboratories, Inc., 261 S. 3rd St., Philadelphia 6, Pa.*

Soldering Iron

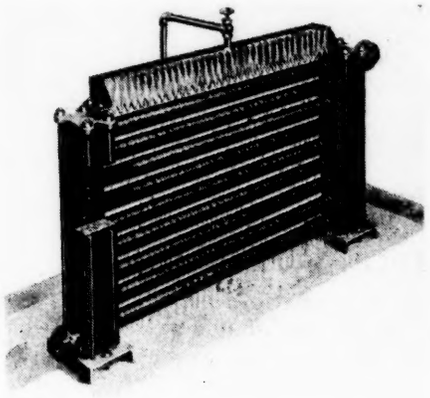
NAME—Industrial soldering irons.
PURPOSE—Designed for severe and exacting soldering operations in industrial plants.
FEATURES—Irons are suitable for light, medium and heavy intermittent soldering as well as for fast, continuous service. Heating units can be easily replaced should a new



unit be required. The chisel-shaped copper tips are calorized which retards corrosion and prevents the tip threads from freezing to the holders. Irons are also supplied with iron-clad copper tips. Plastic handles are cool and easy to grip.
SIZES AND CAPACITIES—From 75 to 300 watts and with tips from ⅜ to 1¼ in. dia.
MADE BY—*General Electric Co., Schenectady, N. Y.*

Cascade Cooler

NAME—Karbate sectional cascade cooler.
PURPOSE—For the cooling of corrosive liquids and gases.
FEATURES—Makers recommend this unit for practically all acids, caustics and organic solvents at pressures up to 75 lb per sq in., and temperatures up to 338F. With minor changes, it can be used for higher temperatures. Cooler sections are 9 ft long and pipe is held in place by



steel tie rod assemblies. Recommended maximum cooler height is 6 ft.

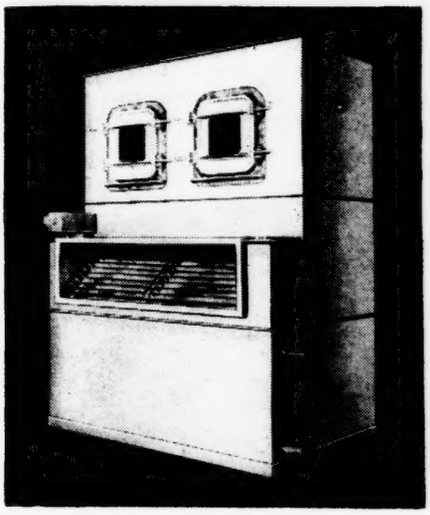
Gaskets are furnished in synthetic rubber or asbestos depending upon conditions. A water distributor, of steel, is mounted on the tie rod assemblies and can be adjusted to provide uniform cooling water distribution over the pipe. Compact construction provides close pipe spacing. Cooler assembly can be easily dismantled for the addition or replacement of interchangeable sections.
MADE BY—*National Carbon Co., Inc., 30 E. 42nd St., New York, N. Y.*

Steel Pipe

NAME—Bart Lectro-clad process steel pipe.
PURPOSE—To provide a lining for steel pipe to make it corrosion resistant.
FEATURES—Process of electroplating the inside of steel pipe with nickel or other metals is said to be relatively inexpensive. Nickel plating can be applied to pipe or tubing up to 18 in. overall diameter and in lengths up to 20 ft. Fittings and pipe line accessories are available for complete piping systems. Pipe can be welded and bent hot or cold, without destroying any part of the internal lining.
MADE BY—*Bart Mfg. Co., 227 Main St., Belleville, N. J.*

Humidity Control

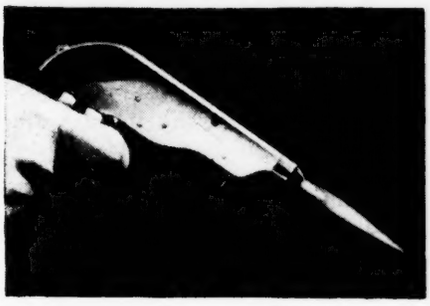
NAME — Kathabar humidity control system.
PURPOSE—Close humidity control for larger industrial applications.
FEATURES—System utilizes an inherently continuous regenerative process thus eliminating cyclic operation with drying agents. It is useful



where low dew point air is required. A single one-path air flow is used. Units are used in processing and other operations requiring controlled humidity atmospheres in amounts from 10,000 to 70,000 cfm. Smaller units are also available.
MADE BY—*Kathabar Division, Surface Combustion Corp., Toledo 1, Ohio.*

Gas Gun

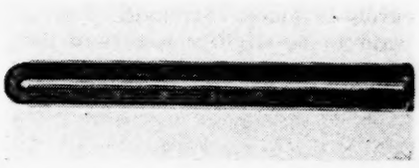
NAME—Century gas gun.
PURPOSE—To provide an automatic lighting system which will save on gas consumption for acetylene torch.



FEATURES—Gas ignites with the pull of the trigger and extinguishes on its release. Variations in flame, with a temperature range of from 950 to 2,000F are obtained by adjusting the pressure regulator. Applications of the gas gun are soldering, light brazing and lead burning, aluminum soldering, sheet metal work, low-temperature welding and tinning.
MADE BY—*Century Aircraft Co., 5601 W. Century Blvd., Inglewood, Calif.*

Cooler Element

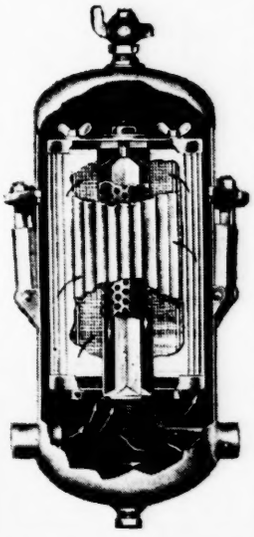
NAME—U-cast hairpin cooler.
PURPOSE—For cooling liquids, particularly for solutions that would normally rapidly attack other metals.
FEATURES—Elements are submerged in the solution to be cooled, and the coolant, usually water, is passed through the element. Sections of the unit are cast of gray iron. Makers claim that these coils have shown a



long life in acid cooling vats where coils of other metals had to be replaced after several months' service.
MADE BY—*National Radiator Co., Johnstown, Pa.*

Filter for Liquids

NAME—Staynew model ELS liquid filter.
PURPOSE—A filter for liquids with a quick change of filter medium.



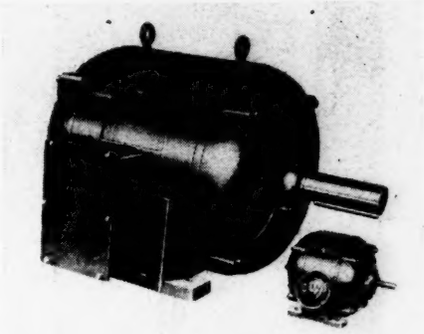
FEATURES — Insert assembly of unit consists of inner and outer radial finned forms of wire cloth. The outer form, on which the filtering medium is crimped, slips over the inner form. Top and bottom plates and seal gaskets are then applied and are held by through bolts. Any filtering medium that comes in sheet form and can be crimped, can be used.
MADE BY—*Dollinger Corp., Rochester 3, N. Y.*

Ammonia Condenser

NAME—Acme lock nut condenser.
PURPOSE—Ammonia condenser so designed that replacement of a tube is simplified.
FEATURES—Design of this shell and tube condenser which holds the tubes in the head by means of a lock nut, lead ring and rubber gasket, makes replacement of tubes simpler.
MADE BY—*Acme Industries, Inc., Jackson, Mich.*

Protected Type Motors

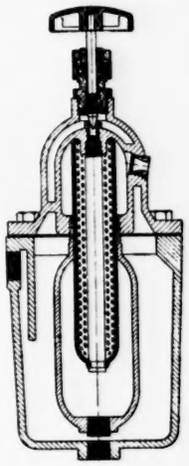
NAME—Crocker-Wheeler protected type motors.
PURPOSE—Motors that are fully protected against dripping liquids, chips and other foreign matter.
FEATURES—The frames of these squirrel-cage motors are basically the same in construction as NEMA standardized frames 326 to 505, with the addition of two shielded, air exhaust openings in the upper half of the frame. Design of these openings precludes any possibility of falling liquids or other substances entering the motor. Company's centrifugal



bearing seal is used in all ball-bearing machines. This permits the use of softer grease for better lubrication and bearing life. Sizes 203 to 404 inclusive have Alucast rotors in which the bars, fans and rings are cast in one operation from aluminum alloys. Rotors of larger sizes have copper bars with brazed-on fans and end rings.
MADE BY—*Crocker Wheeler Division, Joshua Hendy Iron Works, Ampere, N. J.*

Humidifiers

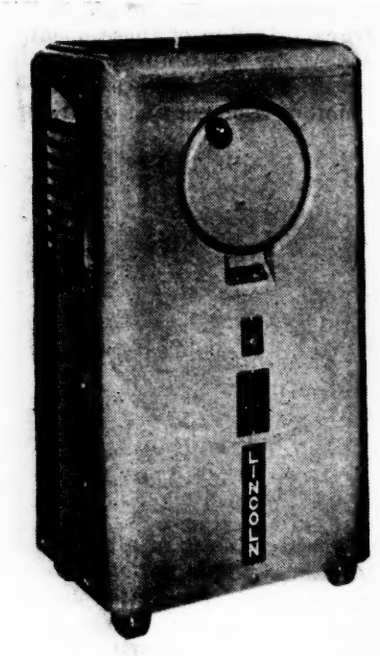
NAME—Armstrong humidifier.



PURPOSE—To use a venturi nozzle for the mixing of steam and air for humidification.
FEATURES — Two models are available—one has a solenoid valve to control automatically the discharge of steam, while the other is manually controlled through a hand operated valve. By virtue of fast steam discharge through the venturi, thorough mixing with the air is assured. As the unit does not have a motor, maintenance is simplified.
MADE BY—*Armstrong Machine Works, Three Rivers, Mich.*

Welding Unit

NAME—Fleet-arc Jr.
PURPOSE—A low priced welder for rural power lines or job welding shops.
FEATURES—Designed for 230 volt, single phase power lines, the unit meets the limited power input requirements of rural utilities. It has a maximum input current of 35 amperes and it can be used with the standard 3 kva power transformer provided by the power company. Current range is from 20 amperes at 20 volts to 180 amperes at 25 volts welding duty. It can handle electrodes from 1/16 to 5/32 in. diameter. The instant the electrode touches the work, the welding current is given a boost of intensity for starting the arc. Current then reverts to the amount set for the job. Current control is of the separate adjustable reactance type which is varied by turning a hand wheel. Unit weighs 360 lb, and is portable.
MADE BY—*The Lincoln Electric Co., Cleveland 1, Ohio.*

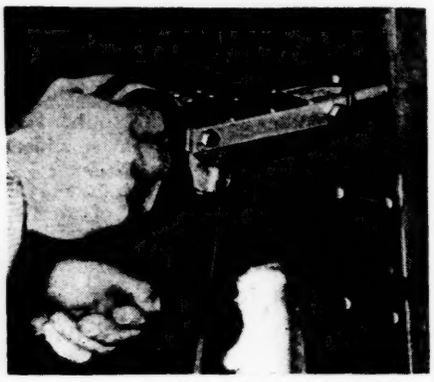


Air Cleaning Tube

NAME—Aerotec air cleaning tube.
PURPOSE—Air cleaning in industrial and chemical plants, intakes on diesel and gas engines, and similar applications.
FEATURES—Device consists of a tube which can be used in multiples up to any desired capacity. Clean air is exhausted from central tube while dust is precipitated from the bottom. Single tube has a capacity of 30 cfm at 4 in. water gage resistance.
MADE BY—*Aerotec Co., 61 W. Chester Ave., White Plains, N. Y.*

Explosive Rivet

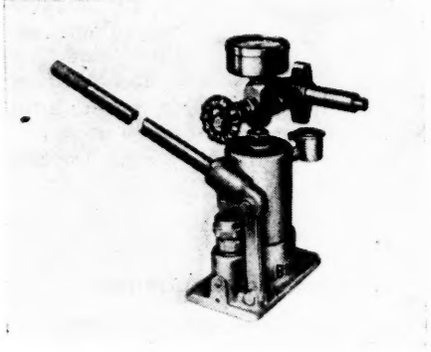
NAME—Du Pont explosive rivet.
PURPOSE—To provide a blind fastener of the explosive type for use in the construction of air conditioning ducts and housings.
FEATURES—An explosive charge in the rivet shank is exploded by an electrically heated iron, and the rivet shank is expanded to completely fill the hole. A barrel-shaped head is formed on the blind to lock the rivet securely in place. Strength of rivets is said to be slightly less than that of the conventionel solid type.



SIZES AND CAPACITIES—Provided in 1/8, 5/32, and 3/16 in. diameters. Made of several aluminum alloys, brass, copper, mild steel and Monel.
MADE BY—*E. I. du Pont de Nemours & Co., Wilmington 98, Del.*

Nozzle Tester

NAME—Buda universal diesel nozzle tester.
PURPOSE—A portable nozzle and injector tester for popular makes of diesel engines.
FEATURES—Unit designed to measure injector operating pressures, check spray pattern, and for detecting such irregularities as sticking needle valves, dribble and leakage around valve seats. Tester has 3½ in. diam. gauge of 3,000 lb capacity graduated in 100 lb steps. Tester weighs 19½ lb and comes with a carrying case with adaptor fittings, special cradle, extra pressure gauges, risers, etc.
MADE BY—*Buda Co., Harvey, Ill.*



Small Induction Motor

NAME—SM-30 capacitor-start induction motor.
PURPOSE—For all applications within the range of a 1/70 to 1/25 hp motor.
FEATURES—The capacitor is approximately 2 in. diameter by 4 in. long and may be attached to the motor at top, side or base. Motor is wound for speeds of 3,350, 1,725 and 1,150 rpm in capacitor or split phase, or 3,100 and 1,550 rpm as a shaded pole motor. Motor has a high starting torque, prompt reversal, and smooth operation. It is built regularly as a ventilated model, but it may be completely enclosed at a reduction in rating. Comes with a cast iron housing but may be produced with an aluminum housing or a pressed metal housing. Comes with ball bearings or oilless sleeve bearings.
MADE BY—*Small Motors, Inc., 1308 Elston Ave., Chicago 22, Ill.*

Temperature Regulator

NAME—Temperature regulator with duo-matic control.
PURPOSE—A means of accurately regulating temperature and pressure with a single regulator.
FEATURES—Regulator is single seated, is equipped with metal diaphragms, and is without packing glands. Wearing parts are hardened stainless steel. A vapor filled thermostatic element acting through the upper diaphragm and lever opposes the pressure limit spring and determines the steam pressure delivered to heat exchanger. Manual compression of the limit spring determines maximum outlet pressure and opens controlling valve to admit high pressure steam from the inlet body port to top of piston which opens the main valve.

Temperature at which the vapor pressure starts to oppose the limit spring and to decrease the outlet steam pressure is set on the adjusting spring. A temperature drop of 1F at bulb reduces vapor pressure, allowing limit spring to open controlling valve.
MADE BY—*Leslie Co., 131 Delafield Ave., Lyndhurst, N. J.*

Temperature Control

NAME—Econostat.
PURPOSE—For regulating the heating system of a building in accordance with outdoor temperature changes.
FEATURES—This control instrument is not new, but the model illustrated is of improved design. Comfortable indoor temperature conditions are maintained by varying the heat-on periods in accordance with outdoor temperature changes. A wide range of adjustments permits the instrument to be adapted to individual installation conditions. Length of time for each cycle, the operating range, the calibration, the amount of night temperature depression, as well as

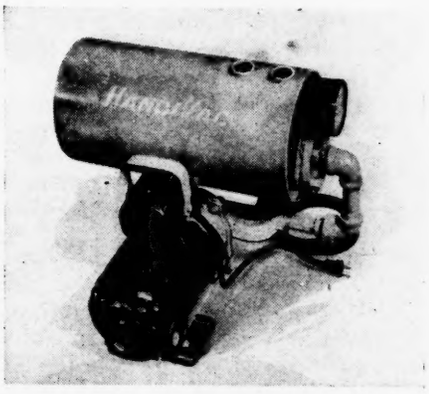
the morning warm-up, are all adjustable. Instrument is equally adaptable to steam and hot water heating systems. It can be used to control motor-operated valves, stokers, and gas or oil burners.
LITERATURE AVAILABLE — Bulletin F-1647-2.
MADE BY—*Barber-Colman Co., Rockford, Ill.*

Lockbolt

NAME—Huck lockbolt.
PURPOSE—To provide a permanently locked fastening device.
FEATURES—Fastener consists of a head of any desired type, locking grooves, a breakneck groove and pull grooves which fit the jaws of the driving gun, and a locking color. After the pin is inserted in the work, the collar is slipped on, and the air gun applied. The collar is squeezed into the locking grooves of the pin to form a permanent lock. The pin is broken off automatically at the breakneck groove and the ejector member of the gun pushes the anvil off the collar to complete the operation.
SIZES AND CAPACITIES—3/16 in. diameter with grip lengths from 1/32 to 21/32 in.
MADE BY—*Huck Manufacturing Co., 2480 Bellevue Ave., Detroit 7, Mich.*

Vacuum Pump

NAME—Handivac.
PURPOSE—For evacuating refrigerator coils, and for countless uses in a laboratory.
FEATURES—Unit is portable and is designed for use where 1 to 4 cfm is sufficient. While no cooling water is required for short periods of operation, for long periods a cooling water flow of 6 gph should be used. Pump has a water connection and



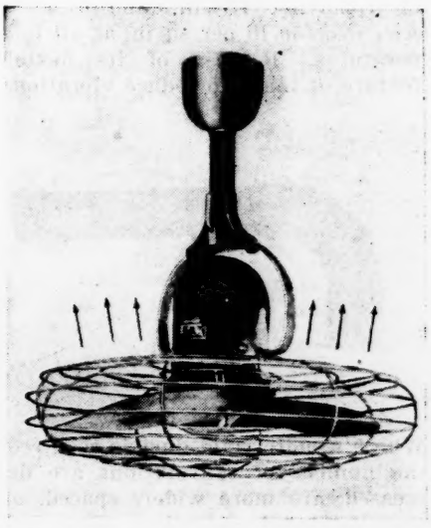
overflow. A vacuum of 28 in. of mercury can be attained quickly. In operation 5 qt water are poured through an air vent and the electrically operated centrifugal pump started. A flow of air is induced through port holes and this evacuates the vacuum chamber. Both water and air emerge from the tail pipe into the recirculating chamber—water is recirculated and air is vented to atmosphere. For a pressure cycle, the overflow and cooling water openings are closed. The ½ hp size can produce 20 in. vacuum in 3 seconds and 28 in. in 10 seconds; 10 lb pressure in 5 seconds and 20 lb pressure in 30 seconds.
SIZES AND CAPACITIES—Motor sizes of 1/4, 1/3 and 1/2 hp with respective ratings of 1, 2, and 4 cfm.
MADE BY—*Whittington Pump & Engineering Co., 245 S. Meridian St., Indianapolis 4, Ind.*

Special Tubing

NAME—High nickel-bearing steel tubing.
PURPOSE—Tubing designed for subzero temperatures for plants handling low temperature fluids.
FEATURES—Steel tubing exhibits good physical properties even at temperatures as low as —32F. May be applied as a substitute for 18-8 stainless steel tubing. This new 9% nickel steel tubing is capable of giving Charpy impact values as high as 25 foot pounds even at —32F. Other uses of the pipe are caustic solution evaporation, and for alkaline-phenol solution work.
MADE BY—*The Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.*

Heat Circulator

NAME—Reco heat circulating fan.
PURPOSE—For circulating heat in hard-to-heat rooms.
FEATURES—This unit is furnished in



ceiling, table and high pedestal models. Fan moves air upward from which point the air moves out and down the walls. Stratification of heat is eliminated and temperatures between ceiling and floor are equalized. Direction of air flow can be changed.
SIZES AND CAPACITIES—Made in 20 and 24 in. dia. sizes. Soon available will be 12 and 16 in. models for smaller rooms.
MADE BY—*Reynolds Electric Co., 2650 W. Congress St., Chicago 12, Ill.*

Dew Point Recorder

NAME—Dew point recorder.
PURPOSE—To provide closer control of the effects of water vapor.
FEATURES—Instrument can provide a virtually continuous record of humidity within a temperature range from —70 to 60F. Units of the recorder are a dew point cup with mirrored surface which can be refrigerated at varying temperature, a thermocouple which is connected to a recording potentiometer, and the refrigerating unit with its associated circulating system.

In operation, gas, after it is filtered, is directed against the mirrored surface of the cup, while refrigerant is circulated within the cup. As the temperature of the refrigerant drops, and the temperature of the mirror decreases, a film forms on the surface when the dew point temperature of the gas is reached. As soon as the film forms upon the mirror, it intercepts a light beam directed on the mirror. The refrigerant flow is shut off and a point record is made.
MADE BY—*Surface Combustion Co., Toledo 1, Ohio.*

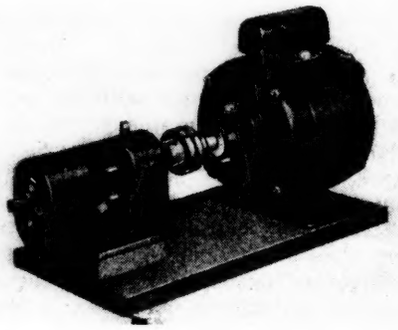
Flexible Duct

NAME—Airtron.
PURPOSE—To provide a duct for hot or cold air.
FEATURES—Made of glass cloth and rubber it withstands temperatures from —60 to 300F without a change of properties. It will stand pressures well over 50 lb per sq in. at all temperatures. Because of its flexible feature, it tends to reduce vibrations.

Where a more rigid duct is required, the number of convolutions are decreased, are more widely spaced, or are eliminated altogether. Duct material is unaffected by water, gasoline, oil and all but concentrated mineral acids. Tube is made in diameters from 1 to 6 in. and in any length desired. Special shapes are also produced.
MADE BY—*Arrowhead Rubber Co., 2244 E. 37th St., Los Angeles 11, Calif.*

High Pressure Pumps

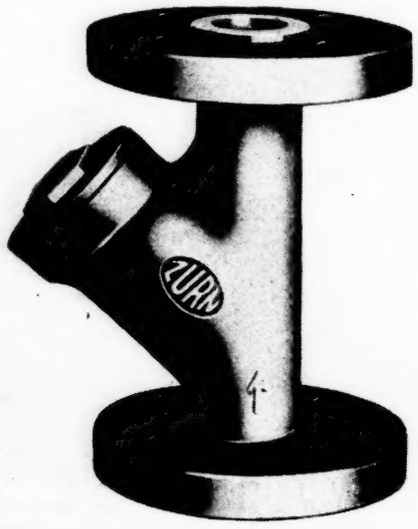
NAME—Bump low capacity high pressure pump.
PURPOSE—For handling thin or viscous liquids at high pressures.
FEATURES—Impellers can be changed to handle any capacity from 60 to 480 gph. It can handle viscous liquids and oil to 1,000 lb pressure. Pump comes in standard foot mounted model to be driven directly by a standard speed motor of 1,200 to 1,800 rpm. Pump can be furnished



for either side intake and discharge, or intake and discharge on the face plate. Seals are either of the conventional type packing or mechanical seals
MADE BY—*Bump Pump Co., La Crosse, Wis.*

Y Strainer

NAME—Zurn Y strainer.
PURPOSE—Strainer that can be installed in almost any position in pipe line.
FEATURES—Strainer sleeve is removable and is so designed that it cannot get out of place or vibrate when in use. Should the purchaser desire, the strainer basket can be magnetized to remove metal particles from



the fluid in the pipe line. Strainers are available with or without a cleanout plug, or can be furnished with a threaded blow-off connection. Fitting is available in several metals and comes in a wide range of sizes for flanged, welded or threaded connections.
MADE BY—*J. A. Zurn Mfg. Co., Erie, Pa.*

Thermostatic Expansion Valve

NAME—Tenney thermostatic expansion valve.
PURPOSE—To regulate the flow of refrigerant into an evaporator.
FEATURES — Valve responds instantaneously to changes in suction vapor conditions. There is no "hunting" due to the absence of any appreciable time lag in control, often found between suction line, bulb, control fluid, and valve diaphragm or bellows. Makers claim that extremely close superheat can be maintained. No special installation is required to prevent loss of control caused by condensing of bulb control fluid in valve body. Compensation for pressure drop in evaporator or distributor has been designed right into the valve. No stem packing is required.
MADE BY—*Tenney Engineering Co., 26 Ave. B, Newark 5, N. J.*

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACTS OF CONGRESS OF AUGUST 24, 1912, AND MARCH 3, 1933, OF HEATING AND VENTILATING, published monthly at New York 13, N. Y., for October 1, 1945.

State of New York,

County of New York, ss.:

Before me, a Notary Public in and for the State and County aforesaid, personally appeared Edgar A. Becker, who, having been duly sworn according to law, deposes and says that he is the Treasurer of The Industrial Press, publishers of HEATING AND VENTILATING, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, as amended by the Act of March 3, 1933, embodied in section 537, Postal Laws and Regulations, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:

Publisher, The Industrial Press, 148 Lafayette St., New York 13, N. Y.

Editor, Clifford Strock, 148 Lafayette St., New York 13, N. Y.

Managing Editor, none.

Business Managers, Robert B. Luchars, 148 Lafayette St., New York 13, N. Y.; Edgar A. Becker, 148 Lafayette St., New York 13, N. Y.; Erik Oberg, 148 Lafayette St., New York 13, N. Y.

2. That the owner is:

The Industrial Press, 148 Lafayette St., New York 13, N. Y.; Robert B. Luchars, 148 Lafayette St., New York 13, N. Y.; Edgar A. Becker, 148 Lafayette St., New York 13, N. Y.; Franklin D. Jones, 148 Lafayette St., New York 13, N. Y.; Walter E. Robinson, 148 Lafayette St., New York 13, N. Y.; Charles O. Herb, 148 Lafayette St., New York 13, N. Y.; Harold L. Gray, 148 Lafayette St., New York 13, N. Y.; Helena E. Oberg, 65-82nd St., Brooklyn 9, N. Y.; Wilbert A. Mitchell, 28 Harlow Road, Springfield, Vt.; First National Bank and Trust Co. of Montclair and Robert B. Luchars, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank and Trust Co. of Montclair and Leigh Roy Urban, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; First National Bank and Trust Co. of Montclair and Kenneth D. Ketchum, Trustees (Beneficiaries unknown), Upper Montclair, N. J.; Paterson Savings Institution, Trustee (Beneficiaries unknown), Paterson, N. J.; Robert Luchars Urban, 51 Ellery St., Cambridge 38, Mass.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are:

Charlotte B. Baldwin, 420 Clinton Ave., Brooklyn, N. Y.; John Connolly, 148 Lafayette St., New York 13, N. Y.; Franklin D. Jones, 148 Lafayette St., New York 13, N. Y.; Robert B. Luchars, 148 Lafayette St., New York 13, N. Y.; Louis Pelletier, 148 Lafayette St., New York 13, N. Y.; Elizabeth Y. Urban, 163 Western Drive, Longmeadow, Mass.; Helen L. Ketchum, 231 King St., Cohasset, Mass.; Wilbert A. Mitchell, 28 Harlow Road, Springfield, Vt.; Henry V. Oberg, 1317 Hillcrest Road, Lancaster, Pa.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bonafide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

EDGAR A. BECKER, Treasurer.

Sworn to and subscribed before me this 1st day of October, 1945.

CHARLES P. ABEL.

Notary Public, Kings County No. 321; Kings Register's No. 116-A-7; N. Y. County No. 325; N. Y. Register's No. 153-A-7. My commission expires March 30, 1947.

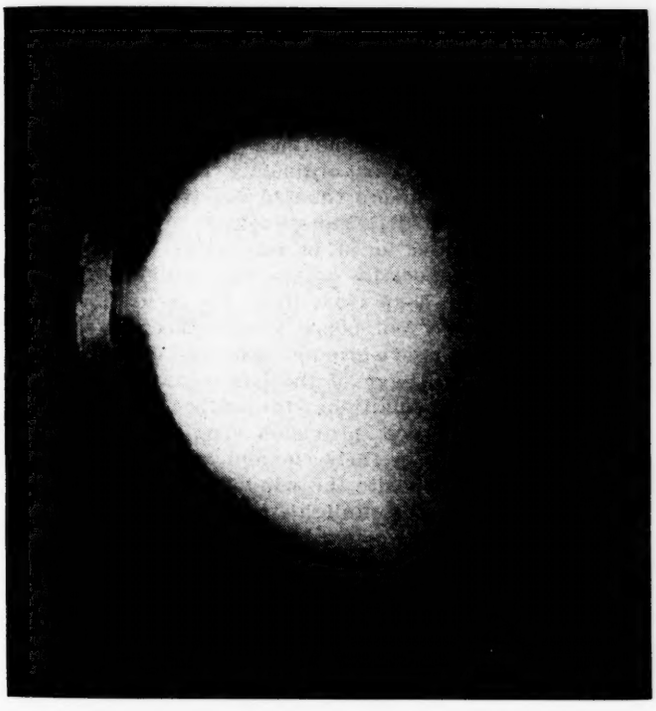
NEWS OF THE MONTH

BETTER BURNING OF FUEL OIL

Special head for gun type burner provides better mixing of fuel and air.

• **BURNING FUEL.**—As a result of research undertaken by Shell Oil Co., Inc., during the war to help consumers obtain maximum heat from the rationed fuel oil, a new type combustion head has been developed which is claimed to cut fuel consumption as much as 20%. The new unit was developed at the company's burner testing laboratory at Sewaren, N. J.

Another factor that prompted the development work is the increasing use of fuels produced by catalytic cracking units. While the new fuel oils have a higher heat content than pre-war fuels, they require more thorough mixing of air and oil. Cracked fuels have a relatively high percentage of aromatic compounds which, due to their chemical structure, are not readily oxidized.



New combustion head maintains efficient flame shape.

• **DESIGN FEATURES.**—The head is designed for the conventional gun type burner which is used in about 75% of the fuel oil installations. It consists of parts which provide primary and secondary supplies of air. The supply of secondary air prevents a vacuum from forming just outside the head while the oil is burning. This vacuum tends to draw the flame inside the burner. The new head also has controls outside of the burner which permit the flame to be moved forward or backward, and which regulate the air.

The measure of burner efficiency is the percentage of CO_2 in the flue gas. Theoretical maximum efficiency is 15% CO_2 which means that just the right amount of air is supplied for burning the fuel. Shell reported a test of the burner head showed 14.7% CO_2 and an overall burner efficiency of 86%. Test of burner with the conventional type head showed a CO_2 flue gas content of 8% and an overall burner efficiency of 67%. In both cases adjustments were made to provide practically smokeless combustion. Stack temperatures when using the new type head, they claim, averaged 410F as compared to 600 to 700F for the conventional burner head.

The new head achieves high burning efficiency by a more thorough mixing of oil and air with a consequent reduction of the amount of cold air intake required. Excessive amounts of cold air intake permit a large portion of the heat to escape by way of the flue.

While the head is applicable to all gun-type domestic burners, the most economical results are obtained when the burner is designed to accommodate the new head.

• **MARKET OUTLOOK.**—This development is particularly timely because a building program of 1,000,000 homes a year is expected for the next ten years, to meet housing demands. Shell marketing experts estimate there will be 3,700,000 domestic oil burners of various types in use by 1950. While marketing plans have not been fully completed, Shell will license burner manufacturers to produce this new head in their new burner units.

In order to increase the heating efficiency of home oil burners and fuels, a test laboratory has also been established by the Socony-Vacuum Oil Co., Inc., as a unit of the company's Technical Service Laboratories in Brooklyn, N. Y.

All this added interest in research regarding the burning of fuel for home heating is largely prompted by developments in catalytic cracking, a process that produces an oil of different characteristics than by other methods.

PENN STATE SPONSORS HEATING CONFERENCE

School of Mineral Industries holds Heating and Housing Conference.

• **FUELS.**—A conference on heating sponsored by Penn State's School of Mineral Industries was held November 14-16 under the name of Heating and Housing Conference. Coal-burning equipment was featured, but such subjects as utilization of basements, radiant heating, summer air conditioning, controls and other allied subjects were all given prominent places on the program.

The Pennsylvania State College School of Mineral Industries is regarded as one of the nation's great centers of learning in fuels and fuel utilization—as befits a state which produces one-third of the nation's coal. In this school, fuel technology is an important phase of work and, in fact, it is the second fuel technology school in the United States in point of age.

• **DEMAND.**—One of the most challenging papers presented at the conference was the first, by K. C. Richmond, editor of *Coal-Heat*, entitled "The Dynamics of Housing and Heating Equipment Demand", in which Mr. Richmond reviewed vital statistics, data on house building; population statistics, and other records to show the enormous pent-up demand for housing that now exists. He pointed out that our population has increased from 106 million in 1920 to 140 million at the present time; that for the last 25 years the marriage rate has run approximately 10.57 per year per 1000 persons and that the number of marriages may be expected to total 15½ million between 1940 and 1950; that in 1943 almost 3 million babies were born; that the difference in birth and death rates is increasing; that families are still shrinking in size, so that during

the 1930's there was a net gain of 5 million families or 16.6% as compared with an increase in total population of only 7.2%; that the average life expectancy is increasing; and that there has been a distinct shift in population from rural non-farm areas to urban communities; that fire, old age and demolition reduces housing at an average of 1.6 units per 1000 dwellings per year; that many of our houses are obsolete and that 3% of them are over 80 years old, 4.4% are between 60 and 80 years of age, and he concluded that 13% of our dwellings are obsolete; that depreciation physically, functionally and economically is no small factor in housing demand, all of which are factors tending to build up a demand for housing. The supply of housing, on the other hand, has had an annual percentage increase of only 2.1% for the period between 1900 and 1939 and the nation's biggest residential building year, 1925, produced only 930,000 new units.

Mr. Richmond pointed out that the temporary National Economic Committee estimated that the market calls for some 600,000 non-farm dwelling units a year, of which 340,000 are required to accommodate population growth, 45,000 to replace those purposely destroyed and 215,000 to replace those units now suitable but which will wear out in time. The National Housing agency, he said, estimates that 12,600,000 non-farm homes and apartment units will be required during the next ten years. Mr. Richmond estimated that for every ten couples getting married, seven or eight new dwelling units are needed and that this alone indicates a need of from 900,000 to one million new dwelling units per year, not taking into account replacement needs, obsolescence, fires and so on.

In other words, he concluded that this country should build not less than three new dwellings per year for every hundred families or around 1,500,000 a year, based on present population.

• **HEATING EQUIPMENT.**—Mr. Richmond pointed out that one out of every 25 furnaces, one out of every 40 boilers, and one out of every 16 heating stoves in use are replaced annually and that this has been the basic sales record since the first World War, and emphasized that two dollars out of every three spent for heating equipment goes for repairs, replacements, and modernization and only one dollar for heating equipment in new houses. Based on the present status of the heating facilities in use in the average house today, the residential building owners of this country could buy during the next few years, Mr. Richmond said, 4.7 million new boilers, 9.6 million new warm air furnaces, 12 million space heaters, 20 million water heaters, 13 million heat regulators, and 10 million stokers, gas or oil burners.

• **DESIGN.**—In his talk on building design and its effect on heating and air conditioning, Professor K. J. Heidrich, of Penn State's Department of Architecture, said that much of the development of architecture depends on the basic considerations of heating or ventilating. He added that our most modern ideas of heating are old and mentioned the radiant heating employed by the Romans and the use of solar heating by the Pennsylvania Dutch in Lancaster County barns.

Professor Heidrich showed with slides how Colonial houses were built around the fireplace, which was the central core in the house, and that modern architecture provides for a great deal more spreading of the rooms since it is not necessary to huddle them around the fireplace. He stressed the desirability of fixed double windows to cut infiltration and heat transmission and with louvers and screens above to provide ventilation when necessary and pointed out the desirability of using deciduous vines for screening the sun from south windows in summer but allowing the sun's rays to enter in the winter. He mentioned that with all of these heat-sealing devices certain problems have arisen such as paint failure, dampness on plaster, frost on the inside of roofs, but pointed out that almost invariably these are caused by too high relative humidity inside the house and suggested that 33% inside humidity is sufficient for a house designed for 0 to 70F and with mineral wool insulated walls.

• **COMMENT.**—Discussing Professor Heidrich's paper, Mr. Levine, of General Electric Company, listed some of the secondary results of modern building practiced such as (1) that insulation increases the mass of the building and, consequently, increases the time lag in heating; (2) that as houses have become more tightly constructed to exclude infiltration, the providing of combustion air becomes more of a problem; (3) that due to the moisture conditions such as mentioned by Professor Heidrich, automatic control of humidity is necessary; (4) that with a great many different types of equipment available, the configuration or design of the house is closely related to the location of the heating or air conditioning unit; (5) that quietness is a feature much more in demand now than formerly; (6) that as our standards of heating have risen, closer temperature regulation is more necessary; (7) that this is also true of air cleaning; and (8) that fuel efficiencies are at the present time limited by condensation in chimneys and that we can expect no increase in certain fuel burning efficiencies until this problem is overcome.

• **BASEMENTS.**—In a paper on proper basement design and its economic advantages, Professor E. L. Whitaker, also of the Department of Architecture of Penn State showed that ordinarily it is cheaper to build complete basements than to dig trenches for the foundation only and that, consequently, at least one of the advantages cited for a basementless house is entirely mythical, especially where the foundation must go below a rather deep frost line. He mentioned that the space per cubic foot below ground is cheaper than comparable space above-ground. Among the considerations affecting the design of the basement are soil and underground water conditions; the walls must be dampproof and mildew-proof; provision should be made for good sized windows in the basement and that perhaps large excavations opposite the windows might be necessary so as to allow the sunlight to come in. In connection with the heating system he mentioned that if coal is selected it must be recognized that the coal must be allowed easy means of being put in and stored efficiently. The coal trucks should not be allowed to touch the lawn and he said that there was no reason why the space under the garage floor would not be a logical place for the coal bin. This gets a lot of coal dust out of the house and also acts as a noise barrier. He stated that in his opinion the coal people have fallen down on the terminal points—coal and ash handling—and said that the bin should be sloped so that effort is not necessary to get the coal out and that proper ash removal and ash storage space should be provided. He suggested that the ashes might be taken out through the same point as the coal was brought in. He suggested that more research be done on coal and ash handling, ways and means of controlling basement humidity, and research on community heating plants.

• **ASHES.**—In discussing coal ash and clinker storage, C. F. Hardy, Chief Engineer, Appalachian Coals, Inc. gave five requirements for a coal bin as follows: (1) accessibility to truck; (2) sufficient storage space; (3) easy way of removing coal; (4) must be dust-tight; (5) the distance from the bin to the heater must be in multiples of three feet to accommodate bin feed screws. He suggested that the size of the bin should be sufficient to hold at least ½ year's supply of coal. In his experience sloped coal bins are not necessary but he suggested that sufficient coal be allowed to form the sloping

walls of the bin itself. In his opinion expensive ash handling systems were not justified because the ash in soft coal should run between 2% and 6% so that only from 40 to 120 lb of ash per ton of coal results.

• **NEW DEVELOPMENTS.**—Colored moving pictures were shown on recent developments in domestic stokers and covering the Anthratube, the Battelle stoker, the Bryant coke stoker, and the Pennsylvania stoker. The latter is a development of engineers in the Fuel Technology Department of The Pennsylvania State College.

• **CENTRAL HEATING.**—E. R. Kaiser, Bituminous Coal Research, stated that Battelle Institute's study of the desirability of central heating plants for groups of houses and covering 41, 81 and 121 houses, with fuel rates as they exist in Columbus, Ohio, today and taking into account even the difference in insurance rates when a central heating plant is used as compared with an individual heating plant in each house showed the following: For a manufactured-gas-fired single heating plant using 537 Btu gas and including the heating of hot water by gas the cost per month in an individual plant totalled $25.74; for an oil-heated house with oil at 7c per gallon but using gas for hot water, $18.93; a stoker-fired heating plant with gas for hot water, $17.24; an all natural gas heated house with natural gas at 55c $16.53. Compared with this, a central heating plant for 41 houses showed a cost per house of $18.06; for 81 houses, $16.28; and for 121 houses $14.46.

Other speakers at the conference included representatives from other departments of the college as well as government and industrial authorities.

REMODELING SIMPLIFIED

Electric tool makes possible installation of pneumatic heating controls in old apartments.

• **HAND TOOL.**—Rejuvenation of old apartment houses so that Minneapolis-Honeywell Regulator Co. personalized heating control can be used, has been made possible by the company's development of a small portable hand held electric buzz saw attached to the end of a vacuum cleaner hose.

The saw cuts a channel in a plaster wall about 3/16 in. wide and deep to accommodate a 1/8 in. copper tube. After the cut is made and the tube inserted, the channel is filled with a filler plastic which in turn is covered with a masking tape of the same color as the existing wall. Later, when the entire apartment is to be redecorated, the tape is removed, and the entire wall painted.

• **COSTS CUT.**—The tool avoids the previous task of chipping large grooves in the plaster wall, and the more expensive job of redecorating the room after the installation was made. Previously, redecoration costs equalled installation costs. With the buzz saw channels can be cut with speeds up to 10 fpm. Adjustment of a guide controls the depth of cut. In an average apartment, the manufacturers claim that to bury the tube, mount the thermostat and install a valve should take no longer than one hour.

The real boon is to the apartment dweller. There is no unsightly wall nor plaster dust. As fast as the dust is created by the saw, it is inhaled by the vacuum cleaner, and discharged into a water filled container.

• **USE RESTRICTED.**—While the tool is not patented, for the present its use is restricted to the Minneapolis-Honeywell men who install the pneumatic controls for the personalized heating system.

This heating system has been installed in more than 200 apartment houses in 16 cities, but most of these have been new buildings or ones undergoing extensive rebuilding.

CONSTRUCTION PICTURE VARIED

Strife and agreement color outlook for construction industry.

• **ACCORD.**—An agreement designed to avoid duplication of effort and calling for a continuous exchange of data and information has been reached between the Department of Commerce and the National Housing Agency, it was announced last month. Signed by Secretary of Commerce Henry A. Wallace and NHA Administrator John B. Blandford, Jr., the accord covers working relations between the recently established Construction Division in the Department's Bureau of Foreign and Domestic Commerce and the NHA.

The understanding sets forth that the NHA "is concerned with the development of adequate information as a guide to policy formation in the field of housing and as a service to the residential building and financing industries as well as local officials dealing directly with housing."

The construction Division, according to the agreement "is concerned with the role the construction industry plays in the nation's economy and in reaching a high level of productive employment . . . it (the Division) will be concerned with the development and improvement of the basic measures of construction activity . . . Its function will . . . be to synthesize information from several government agencies and a variety of private sources in order to build up an adequate over-all picture of the construction industry."

• **DEBATE.**—Speaking on the weekly Business Forum presented by the Commerce and Industry Association of New York, over Station WMCA, Wadsworth Likely, founder of the national American Veterans' Committee, said: "What the veteran wants most is to become as completely a civilian as possible. We don't want to be separated from the people we left behind. But the fact that throughout the nation 1,100,000 veteran families will be faced with no place to live is a potent reason why we veterans might set ourselves up as a special group demanding special privileges. You civilians don't

want that; and the American Veterans Committee certainly doesn't."

Other speakers on the Forum discussing "Can New Rental Housing Be Built Under OPA Regulations?" were Ivan D. Carson, Deputy Administrator for Rent, Office of Price Administration, Washington, and David Tishman, president of the Tishman Realty & Construction Company, New York. Association Secretary Thomas Jefferson Miley was Moderator.

• **NEGATIVE.**—Answering the question posed in the Forum "Can New Rental Housing Be Built Under OPA Regulations?" Mr. Tishman replied: "On the basis of OPA performance up to this time, my answer is an emphatic no. OPA persists in maintaining a policy for new rental housing which—far from encouraging new construction—makes it impossible. The OPA formula ties the rents in new construction to 1943 depression-level rents . . . Yet construction costs now are above those of 1929—the big boom year—to say nothing of the very substantial increase in operating costs. What is needed is a free market for new housing accommodation. Such a market will encourage builders to begin construction at once. And at the same time not a single rent in existing housing will be increased."

• **POSITIVE.**—Speaking in clarification of the OPA policy, Mr. Carson said: "No Government agency is at the present moment more acutely aware of the need for increased rental housing than the OPA Rent Department. . . . We also are aware that any high level of employment and general prosperity depends upon a high volume of construction. On the one hand, we want to provide an inducement for builders to get moving as soon as materials are available. At the same time, however, it is our responsibility to give some measure of protection to the prospective tenants, particularly veterans. There are some who will be tempted to charge fantastic rents in the face of the present terrific housing demand.

"Without control over rents on new housing, a dangerous inflationary spiral would be started, wild bidding by desperate home-seekers would force rents sky-high. The best-intentioned builders could not prevent it.

"There are two factors upon which the rent standard is based," Mr. Carson pointed out. "First, what is the rent for comparable accommodations on the maximum rent date? When that has been determined by the area office, we inquire into the increased cost of construction today as contrasted with the cost in 1939, the last year preceding the war when building material prices were generally stable. After an appropriate estimate is made for these increased costs of construction since 1939, the equivalent in rent is added to the comparable rents for similar rental housing already existing."

• **SELF-REGULATION.** — Douglas Whitlock, chairman of the advisory board of The Producers' Council, national organization of building product manufacturers, advised the construction industry to embark on a program of self-regulation as a means of avoiding the danger of expanded governmental control which, he said, would reduce the future volume of building and restrict employment for construction workers.

• **HOME BUILDERS ENCOURAGED.**—An official statement that the Office of War Mobilization and Reconversion will initiate no action to put price ceilings on finished houses should go far toward removing the many uncertainties in the home construction business, Joseph E. Merrion, President of the National Association of Home Builders of the United States, asserted at the concluding session of a meeting of the Construction Industry Advisory Council of the Chamber of Commerce of the United States.

When the war ended, Mr. Merrion said, "we knew of some of the handicaps we would face—shortages all down the line in materials and supplies," and the industry was prepared to cope with them.

"But then there was added the threat of unworkable government controls and, above all, great uncertainty," he continued. "Now the statement of John W. Snyder that the Office of War Mobilization and Reconversion will not ask Congress for ceilings on finished homes gives us a tremendous lot of encouragement. We can go ahead with our plans."

• **BUT NOT UNANIMOUS.**—That Mr. Merrion's remarks represent less than 100% of the sentiment of his association is evidenced by a telegram which was read into the Congressional Record by Representative Wright Patman of Texas:

DALLAS, TEX., *October 8, 1945.*

HON. WRIGHT PATMAN,
House of Representatives,
Washington, D. C.:

As one of the largest home-building firms in Dallas, we are heartily in favor of your fight to maintain price ceilings on new homes. Such ceilings are absolutely necessary to protect returning veterans and the general public, and for the best interest of the building industry. With price controls in general favor on new cars, radios, and other scarce goods, why should the public be placed at the mercy of the home-building industry? Rigid and strictly enforced price ceilings on all building materials and on the completed house and lot are imperative to prevent chaotic inflation and a repetition of a disastrous building boom of the twentieth period. The claims that the building industry will police its members to keep prices in line and that competition among builders will hold prices down, is sheer nonsense. The city of Dallas needs 10,000 new homes. Until at least six or seven thousand have been built, it will be strictly a sellers' market, with the only competition being that of bidding of builders for labor and materials, causing a continued upward spiral in prices, all of which to be passed on to the public. The argument that ceilings and controls will prevent construction of new homes can be quickly exploded by examining the record of the title VI housing program, in which private builders constructed record number of housing units under most rigid controls. With adequate materials and labor and an unprecedented demand, the houses will be built. The only question is whether they will be sold at reasonable prices with fair profit or at inflationary and profiteering prices. Price ceilings on the completed house should be determined by the FHA, using OPA prices of materials. FHA already has adequate machinery for determining fair ceiling prices. We plan to start 50 houses in next few weeks, and to build 300 next year, and we will welcome the placing of ceiling prices thereon. We believe that this opinion is shared by many builders interested in a fair profit but not in profiteering. Letter with additional suggestions follows, air mail. If you will secure air-line priority and make hotel reservations, one of us will come to Washington at our expense to testify in this matter if it will help your fight. We are members of National Home Builders Association.

LEWIS & LAMBERTH.
H. D. LEWIS.
E. P. LAMBERTH.

• **HOME PLANNERS' AID.**—A new ally to the home building industry is swinging into action in a number of cities with plans to establish a home planning bureau and information center for the public.

A few home planning bureaus already have been announced by local gas companies. Many more such announcements are expected from other cities since most gas companies in the country have studied the organization of a bureau, or will have studied it before the year closes.

Behind the home information center idea is Surface Combustion Corp., Toledo, O., manufacturer of Janitrol gas-fired heating equipment. However, what started out two years ago as a post-war plan for the manufacturer,

PREFABRICATION with Tube-Turn welding fittings can effect important savings. Particularly is this true where piping must fit into tight space—up against a wall or ceiling, into narrow pits under floors, or in a ship, to cite only a few examples. It takes elbow room to tighten bolts and screw flanges, but a prefabricated section can be fitted into tight spots easily—and economically.

Such sections are as strong as though originally forged in one piece. Each elbow, tee and flange is welded with a joint actually stronger than the pipe itself. Tube-Turn welding fittings contribute to the best possible piping job, whether the problem be new construction, replacement, or assembly into a manufactured product.

For complete information on the superiority of Tube Turns' exclusive manufacturing methods and data on successful installations in many industries, write for Catalog 111.

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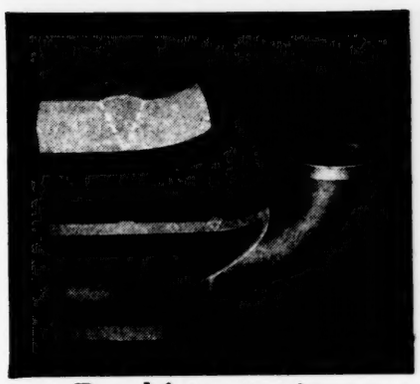
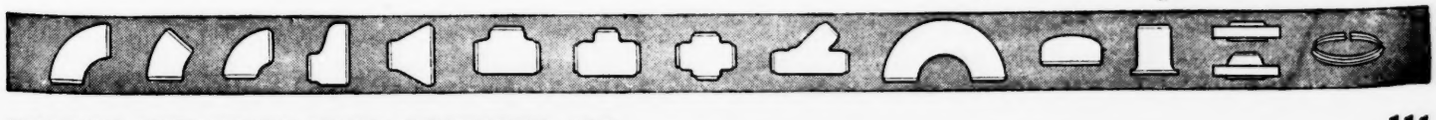
TUBE TURNS (Inc.), Louisville 1, Kentucky. *Branch Offices:* New York, Chicago, Philadelphia, Pittsburgh, Cleveland, Dayton, Washington, D. C., Houston, San Francisco, Seattle, Los Angeles.



Fused into one piece

See how fitting and pipe are fused into one solid piece of metal, the welded joint actually stronger than the pipe metal itself.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*



grew and developed to the point that the American Gas Association said "this would be a boon to the entire industry," and thereby sponsored the home planning bureau idea.

• **OPA ACTS.**—To simplify and speed the pricing of some essential building materials in localities where construction is about to be resumed, Office of Price Administration regional administrators may authorize district directors to establish uniform dollar-and-cent community-wide ceiling prices on these goods, OPA said last month.

In an action, effective November 5, 1945, OPA authorized regional administrators to re-delegate to district directors the job of fixing community ceilings on selected building materials. In two actions to be issued shortly, the authority will be made specific with respect to Douglas fir plywood and doors, stock millwork, stock screen goods, mechanic or building equipment and some construction materials. Installation charges also may receive community ceilings, OPA said.

• **ESTIMATE.**—Total new construction in the United States during 1945 is expected to total at least $4.4 billion, or 10 per cent more than in 1944, and the September rate of private construction reached the highest level since May, 1942, according to the Current Industry Report on Construction and Construction materials published by the newly-organized Construction Division, Department of Commerce.

The report said that the cumulative value of new construction for the first nine months of 1945 was $3,317 million, an increase of $234 million, or eight per cent, over the comparable 1944 period. A gain of more than two-fifths in private construction was responsible for this advance as public work declined 14 per cent.

• **BY PC.**—The volume of new construction next year is estimated at about $7.4 billion, an increase of 60 per cent over total expenditures in 1945, Charles E. Young, Economist of the Westinghouse Electric Corporation, and member of the Market Analysis Committee of the Producers' Council, stated in an address before the Council.

"Private building is expected to reach $5.2 billion, or 70 per cent of the total, with public works and other publicly financed construction amounting to about $2.2 billion," Young said.

• **AND DC.**—New construction in the United States, public and private, will reach $7,300,000,000 in 1946 and additional expenditures on repair and maintenance will boost the total by at least another $5,000,000,000, according to revised estimates issued by the Construction Division, Department of Commerce.

According to William H. Shaw, chief of the Division's Construction Statistics Unit, construction in 1946 should be 60 percent better than in 1945, if present expectations are fulfilled.

• **FOR SALE.**—Recent announcement by the Federal Public Housing Authority of a temporary war housing re-use demonstration to open in Washington in December has already resulted in a large indicated demand for government temporary housing material when it becomes available.

The Federal Public Housing Authority has issued instructions lifting wartime restrictions as rapidly as possible on occupancy of 60,114 completed permanent war housing units which were provided with funds originally intended for housing low-income families. The action constitutes the first step toward the conversion of these dwellings to peacetime low rent use.

The action follows an order by Administrator John B. Blandford, Jr. of the National Housing Agency authorizing its constitutent, the FPHA, to proceed with termination of this housing for war use.

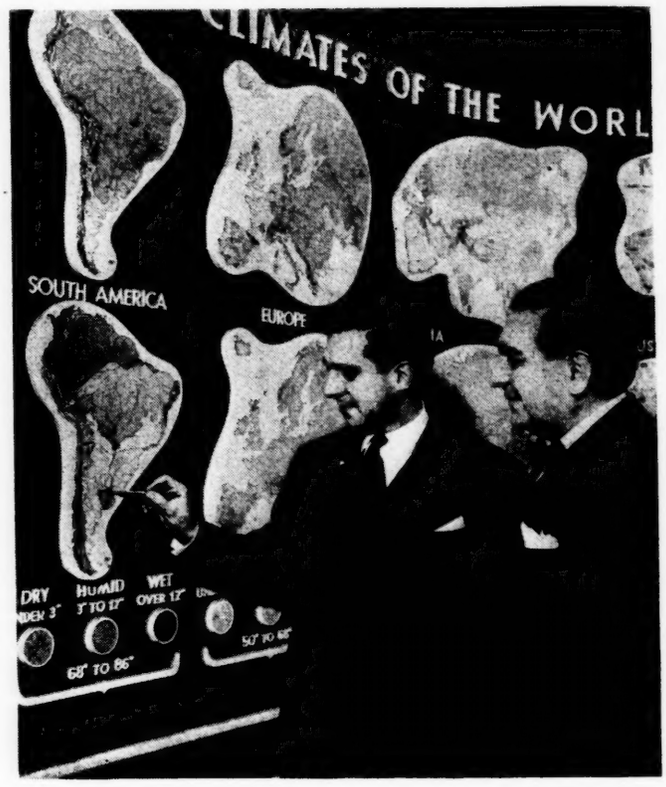
STUDY ARGENTINE MARKET

Air conditioning and refrigeration equipment has export possibilities.

• **EXPORT.**—Air conditioning and refrigeration equipment has excellent export possibilities in Argentina, Ernesto Lix Klett, president of Carrier Lix Klett, S. A., Buenos Aires, said in New York last month.

"All specialized equipment is in demand in the Argentine," Mr. Lix Klett stated. "Shipments of manufactured products were light during the war years, and Argentina's highly developed industries will require increasing quantities of such equipment."

• **PIONEERS.**—Carrier Lix Klett, S. A., has bulked large in the promotion of air conditioning in the Argentine. In 1933, the company installed Carrier equipment in the world's first completely air conditioned apartment building. That same year, it also completed an installation in a 32-story apartment building, still the largest fully air conditioned apartment house in the world.



Ernesto Lix Klett, right, and his son, Ernesto, Jr.

Buenos Aires also boasts the world's largest entirely air conditioned bank building, a Carrier Lix Klett installation. A new addition to the world-famous Plaza Hotel, most of Argentina's important hotels and restaurants, and virtually all hospital operating rooms, are Carrier air conditioned by Lix Klett.

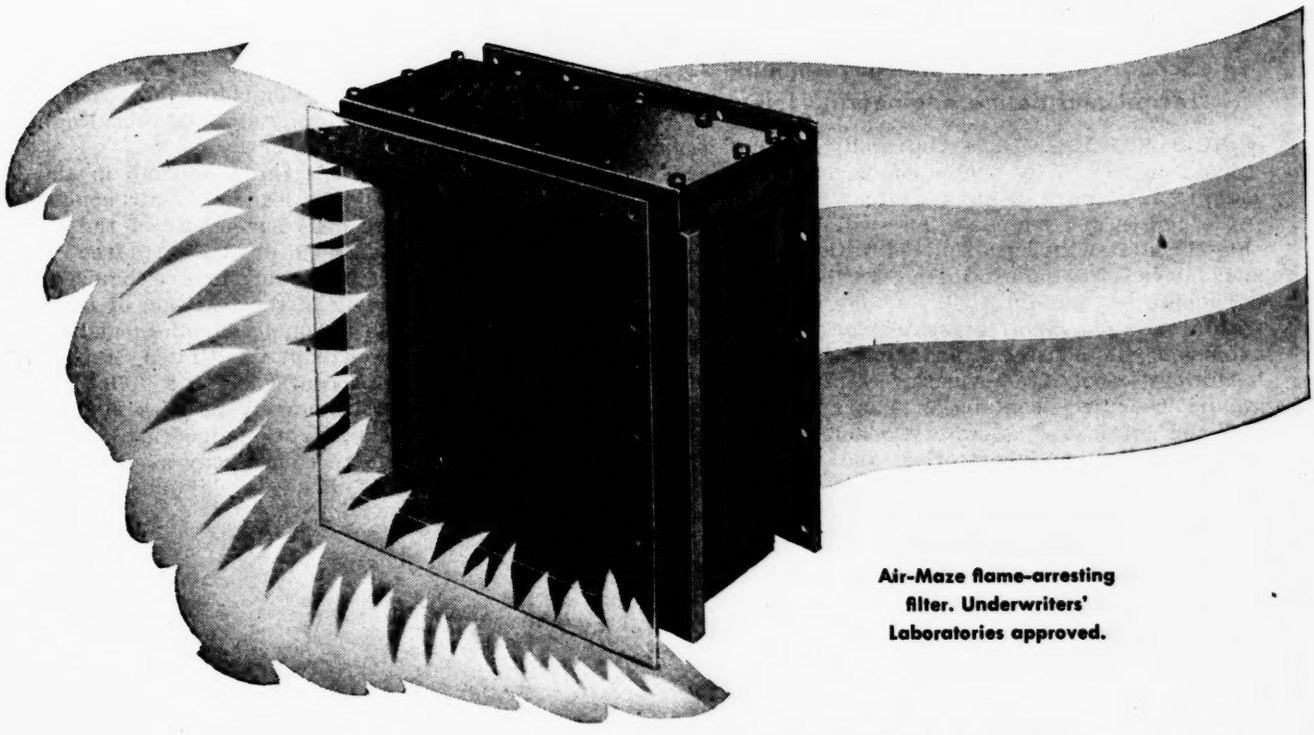
"Public response to these installations indicates wide acceptance of air conditioning," Mr. Lix Klett declared. "I believe all kinds of air conditioning, both portable and central station, have a broad field of potential users."

• **GOOD NEIGHBORS.**—A Cornell graduate, Mr. Lix Klett is renewing old friendships during his stay in New York. Ernesto, Jr., a director of Carrier Lix Klett, S. A., will visit Carrier home offices and plants in Syracuse, N. Y., to inspect new models and study recent manufacturing developments.

Mr. Lix Klett praised air travel as doing much to im-

WHEN ONE EXPLOSION CAN BREED ANOTHER...

THIS "SNUFFER" KEEPS FLAME FROM SPREADING



Air-Maze flame-arresting filter. Underwriters' Laboratories approved.

—another example of Air-Maze engineering

In mines, grain elevators, liquid storage holds of ships—perhaps in your own building or plant—one explosion may set off others like a string of firecrackers. Flames blasting through ventilators can start a dozen infernos in an instant.

Air-Maze engineers have now developed á flame and explosion-arresting panel only 4 inches thick. This "snuffer" is open enough to permit air to pass through freely, yet it has the amazing ability to prevent an explosion on one side from igniting even an air-gasoline mixture on the other side.

This flame-arresting "by-product" of 20 years of specializing in air filtration is typical of the thousands of unusual developments pioneered by Air-Maze engineers. Whether your problem has to do with ventilation, humidity control, flame arresting, intake air filtration and silencing or fine particle filtration of liquids—bring it to Air-Maze.

AIR-MAZE CORPORATION, Cleveland 5, Ohio. *Representatives in Principal Cities. In Canada: Williams & Wilson, Ltd., Montreal, Quebec, Toronto, Windsor; Fleck Bros., Ltd., Vancouver, B. C.*

prove business and social relations among the countries of North and South America.

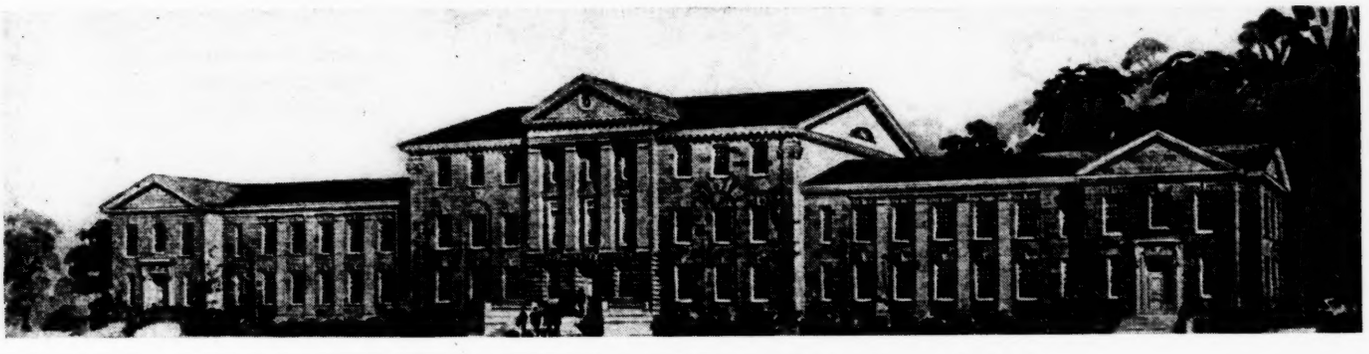
"Never in previous trips have I seen so many Argentines here in New York," he said. "A really friendly spirit among peoples of various nations depends on how well each understands the other, and the work of U. S. airlines in providing speedier travel among the Americas has been a potent contribution to a true 'Good Neighbor' policy."

ENGINEERING GROUPS SPUR EDUCATION

Schools, industries, and governments seek to recruit and define engineering talents.

• **NEW SCHOOL.** — The University of Buffalo broke ground on Nov. 5 for a new engineering building. The building is planned in three sections, only one of which —the center and main section—will be constructed at this time. It will be completed within a year. Green and James, of Buffalo, are the architects.

The present building will be four stories in height, with a one-story laboratory extension at the rear. This extension will house the main mechanical engineering laboratory having 7,000 square feet of floor space. The ground floor will contain an instruments laboratory, fuel and lubricants laboratory, machine tool and production inspection laboratories, and two class rooms, designed for the use of visual aids.



Proposed new engineering building for University of Buffalo.

The first floor will have a heat treatment laboratory, materials testing laboratory, and office and class room facilities. The second floor is reserved for the electrical laboratories. It will also contain a constant-temperature, windowless room to house the gage laboratory which has been transferred to the University of Buffalo by the Army Ordnance. The third floor provides 5000 square feet of drafting room space.

Dr. Samuel P. Capen, Chancellor of the University, pointed out that the engineering building is a necessary part of the expansion program announced by the university in 1944 when its four year curriculum in mechanical engineering was begun. The building will house the department of mechanical engineering, which has already grown to unexpected size and will provide the nucleus for expansion which is expected to include electrical and chemical engineering in the near future. The building, when completed, will be 307 ft wide—widest of any of the campus buildings.

Prof. Paul E. Mohn, head of the department, said, "A full-time student body of 285 in engineering by 1948 is now indicated, exclusive of the growing numbers in evening classes. A large percentage of today's registration consists of returned veterans and the prospects point to even larger numbers as more service men and women are released."

There is an active student engineering society sponsored by the Buffalo Section of the ASME.

• **AIR CONDITIONING COURSE.** — Charles S. Cave, Product Application Engineer, Chrysler Corporation, Airtemp Division, has been chosen to teach the new 4-year night college course in Air Conditioning offered by the Dayton YMCA College to students who wish to become proficient in air conditioning engineering, officials of the college announced recently. The class started in September with enrollment "pegged" for the present time at 20 students.

The 4-year night course was developed by an Advisory Committee on Air Conditioning chosen from engineers well known in the industry. The course consists of the essentials for a well-rounded, practicable knowledge of the art and science of air conditioning. When a student successfully completes the 4-year night course, he receives the title, "Associate in Engineering Administration."

• **UNIQUE.**—This is the first time in the history of air conditioning that leaders in air conditioning engineering who are active members of the industry have had the opportunity to draft a "frill-free" course of instruction, put it into being in a recognized school, and participate actively in the teaching of the course.

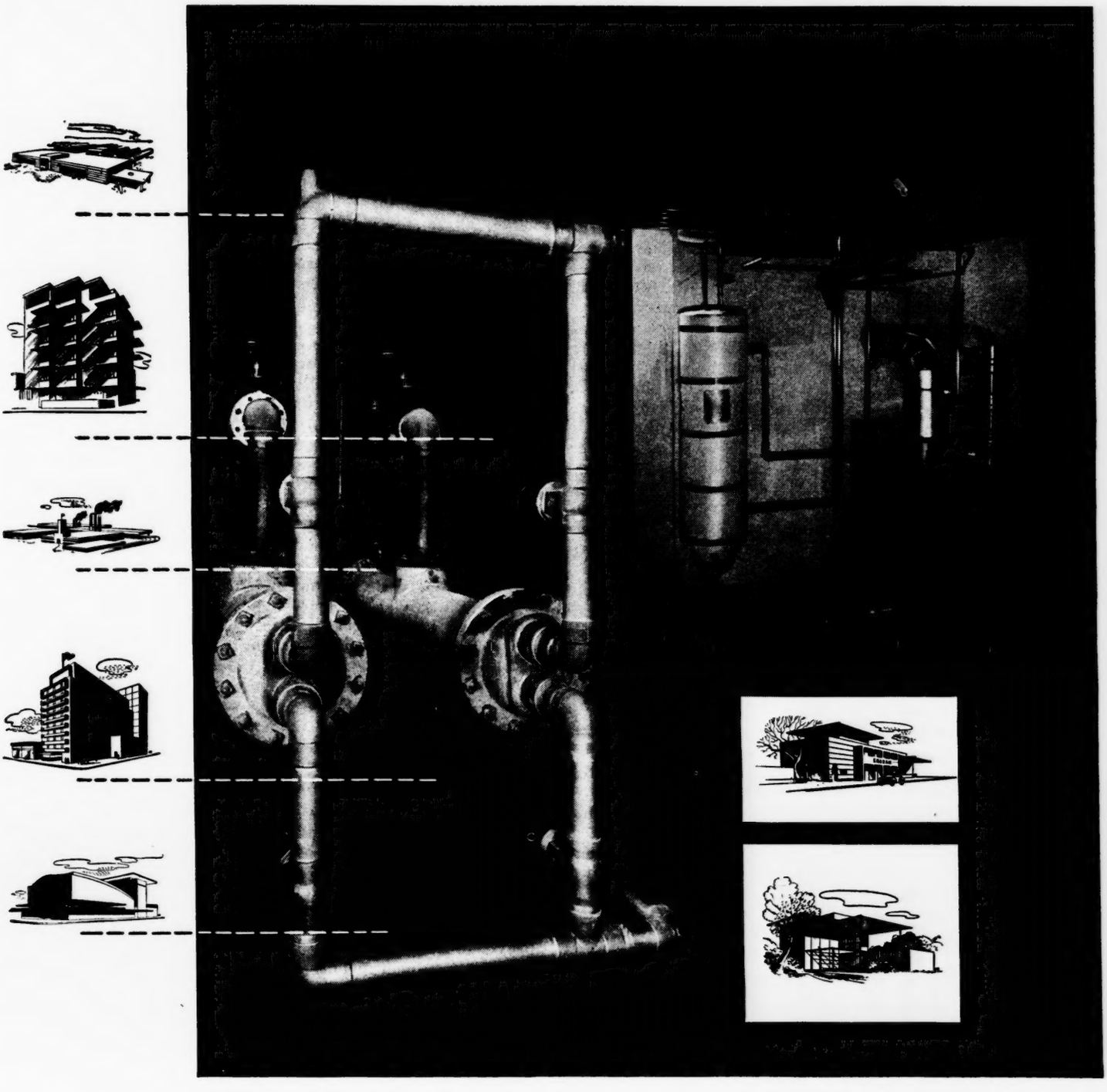
Because of its uniqueness, college and university administrators throughout the United States and Canada are watching this course. It is a "pilot" course which will be adopted in entirety or with slight changes, by many other colleges of engineering. There is much probability that the course may also be offered by the Dayton YMCA College in daytime session. In that event, students attending the college full time could complete the course of study in much less than four years. Also, the lecture portion of the 4-year course may be set down on paper and offered as a correspondence course to those whose occupation and previous experience in Air Conditioning are equivalent to the laboratory instruction necessary in the course, and can prove it, and who cannot attend classes.

Qualifications for enrollment in the course were a high school education—or its equivalent—a sincere desire to become proficient in air conditioning engineering, and a credit to the profession after graduation.

• **COAL MERCHANTS.**—Some 120 Chicago coal merchants, enrolled in the combustion engineering educational course sponsored by the Chicago Coal Merchants Association, traveled to Mendota, Illinois, last month as guests of the Conco Engineering Works, manufacturers of Conco Stokers and other heating equipment. The visit was arranged by James D. Rooney, Executive Vice-President and Thilo Best, Chairman of the Engineering Committee of the Chicago Coal Merchants Association.

The meeting included an escorted tour through the Conco plants and an inspection of Conco's experimental laboratory and engineering department.

In the afternoon, a formal meeting was opened by an address by Walter Sormane, general sales manager of



COPPER MAKES ANY BUILDING BETTER

No matter how you look at it, a copper tube installation improves a building. Not only by keeping heating and water lines clean on the inside—for unobstructed flow and clear water—but also by slowing depreciation. Any open-minded owner will easily understand why the use of copper lines saves him money. What's good for buildings and their owners is good for the engineer and contractor. You can rely on copper to back up your professional reputation.

Revere Copper Tube (99.9% pure copper) is seamless and is cold drawn with a gun-barrel finish inside. It is deoxidized, and is free from flaws and blemishes. Joints are made with either soldered or compression fittings.

Designed for heating, air conditioning, water supply and other services, this tube is stamped with the Revere name and the type at regular intervals. Look for these identification marks—they insure full wall thickness and the close gauge tolerances that are so necessary for tight sweated joints.

In making your plans you can specify such Revere materials as copper tube and pipe; Red-Brass pipe; sheet copper for tanks, ducts, pans and trays; sheet Herculoy for tanks; Dryseal copper refrigeration tube (dehydrated and sealed); copper oil burner, heat control and capillary tubes.

Revere materials are handled by Revere distributors in all parts of the country. The Revere Technical Advisory Service, Architectural, is always ready to serve you. Call Revere.

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Conco and was followed by short lectures delivered by John Roland and E. A. Field of the Conco engineering staff. An open discussion on stokers, combustion, barometric draft controls and other related subjects followed.

• **HAGAN PAYS TUITION.**—By encouraging development of existing personnel, one Pittsburgh organization has set in motion a plan to fill the current gap in the stream of young chemistry and engineering students, caused by the war. As an investment in the future of their own personnel, Hagan Corp. and its subsidiaries, Hall Laboratories and Calgon, Inc., announced a broad-gauge plan to back members of their staff in getting college educations in night school which will serve to up-grade them in their work with the three companies.

The companies will pay half the tuition and fees for any course the individual enters, and on attainment of a degree, will pay the other half, according to Dr. Everett P. Partridge, picked by President J. M. Hopwood to supervise the plan.

The idea is a recognition of the fact that many technical staff members already have given years to night school courses to improve themselves at their own expense and that the companies stand to gain from this broadening of horizons through college or university courses in chemistry, engineering or other subjects.

Hagan Corporation is an engineering organization specializing in systems for combustion control of industrial boilers and furnaces, its work branching out into many other fields involving control in the last few years. It seeks to develop engineering talent at home office and in field service work. Hall Laboratories, headed by Dr. R. E. Hall, who pioneered in work on scale and corrosion in steam boilers, requires young chemical talent for its laboratory analysis and research work, besides attempting to develop men who can service industry in water conditioning. Calgon, Inc., which adapts Dr. Hall's work to the uses of textiles, foods and a score of other industries, seeks to develop men and women with chemical knowledge which will prove helpful to those industrial and commercial fields.

Thus the three companies feel they have a real stake in the upgrading of their present members who have the initiative and stamina to tackle tough night-school courses.

• **THE PLAN.**—The plan will be continued as long as the results justify the expenditure, although the details may be modified in successive years on the basis of experience. For the year 1945-46, the procedure will be:

1. Any member of the associated companies who is eligible to register for under-graduate or graduate courses of instruction in a curriculum leading to a bachelor's or an advanced degree in a field related to the technical or business activities of the companies may participate in the plan.

2. On presenting to the company the receipt for tuition and fees for any current course in a curriculum as noted above, the participant will be paid one-half of this amount.

3. If, in the future, the participant successfully completes the required curriculum and receives a degree while still in the employ of the companies, he will then be paid the remaining half of all receipts for tuition and fees presented to the company during the period from date to the granting of the degree.

"Participation in the plan," Dr. Partridge points out, "does not relieve any member of the organization from regular or emergency duties which may on occasion require him to absent himself from classes, although an effort will be made to interfere as little as possible with the educational program of each participant.

"The money to be expended under this plan is considered as an investment; the dividends anticipated from it are the better understanding of and more intelligent attack upon our many problems in the coming years."

In time, the flow of new men and women into chemical and engineering fields is expected to resume, but the Hagan-Hall-Calgon educational plan is intended for long-range, to stimulate those members who want to get ahead.

• **NOT EASY.**—"Theirs will be no easy course, however," Dr. Partridge warns. "It is never simple to work all day at a job and pursue further education in technical fields at night."

• **CONFERENCE.**—The best way to train engineers, and how to maintain this country's leadership in science, were among the many topics of vital importance discussed at a conference in Pittsburgh. The Carnegie Institute of Technology was host to more than two hundred engineers and physicists from industrial, government, and educational institutions throughout the East and Middle West. Entitled "Instrumentation and the University," the conference was sponsored jointly by the Carnegie Institute of Technology and the Instrument Society of America.

Other topics discussed included the types of instruments needed in atomic research, in the aviation and rubber industries, and in the further development of radar, the importance to society of the methods of science, cooperative programs with universities, and how surplus equipment may be used to advantage in education.

• **PENN.'S NEW LAW.**—The Pennsylvania State Legislature has recently passed a new "Professional Engineers Registration Law" known as Act No. 367 (Senate Bill No. 618) which, according to spokesmen for the Pennsylvania Society of Professional Engineers, has teeth in it, provisions for examinations and penalties.

The innovation in this Act is the classification "Engineer-in-Training." This provision is made so that an applicant can take his examination in fundamental engineering principles when he is best fitted to do so. This is equivalent to the preliminary examination in Law or Medicine. Following the practice of the Legal and Medical professions, if an applicant is a graduate of an approved engineering institution, he is granted a Certificate of Engineer-in-Training without an examination. Thereafter, all he needs to pass, after he has had the required four years of experience, is an examination in Engineering practice. Applicants who are not graduates can take these examinations separately or at the same time.

The years of experience of a graduate have been increased to four to meet a similar requirement of all other states and makes possible reciprocity on an equal basis.

WESTINGHOUSE IN HEATER FIELD

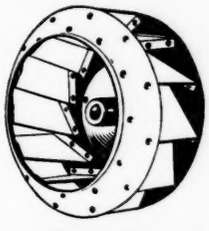
To produce unit-type electric heaters primarily for west coast.

• **LICENSED.**—Westinghouse Electric Corp. enters the field of electric heating of homes under the terms of a license granted by the Wesix Electric Heater Co. of San Francisco transferring the right to use basic designs for unit-type electric heaters.

• **NEW MODELS.**—The Westinghouse plant at Emeryville, Calif., will go into volume production of a complete new line of models ranging from a portable 1250-watt, 110-volt floor unit to four-kilowatt, 220-volt, floor and wall models.

Stuart L. Forsyth, formerly of Pittsburgh, will head the new venture as sales manager. "We expect our major markets will be California, Washington, and Oregon where ample power is available at low cost, making electric heating of homes economically feasible," Mr. Forsyth said.

Scheduled BREAKDOWN ...to give you better centrifugal fans!



TESTED to destruction this fan impeller flattened like a pancake. Yet the blade riveting of the fan didn't fail!

It's a centrifugal fan impeller, used on blowers and fans for exhausting or supplying air in ventilating and air conditioning systems on marine vessels, in commercial or industrial jobs.

Turning at 5000 revolutions per minute at the time of destruction . . . a tip speed of around 25,000 feet per minute . . . the fan cone and backplate were merely compressed by the terrific stresses set up! Maximum operating speed of the fan is 1750 rpm, and USAIRCO engineers wanted to check calculations and to observe the effect on the blade riveting at excessive speeds.

No ventilating fan of this size and type will turn at such a high speed, but a wide margin of safety in the fan design means longer-life and greater-dependability for the fan user. In fabricating the impeller from heavy gauge steel, hydraulic riveting is used to anchor the blade securely to the fan cone and backplate. The result is a stronger and more durable fan impeller. This test proved that USAIRCO engineers were right!

If you're looking for dependably-built, longer-life centrifugal fans for your next ventilating job, it will pay you to specify USAIRCO centrifugal fans. . . . There is a fan size to fit your own particular requirements.

UNITED STATES AIR CONDITIONING CORPORATION

Makers of the most complete line of air handling equipment • Factory Representatives in Principal Cities

NORTHWESTERN TERMINAL I.C.I. MINNEAPOLIS, MINNESOTA

Degree-Days for October, 1945

HEATING AND VENTILATING'S 19TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

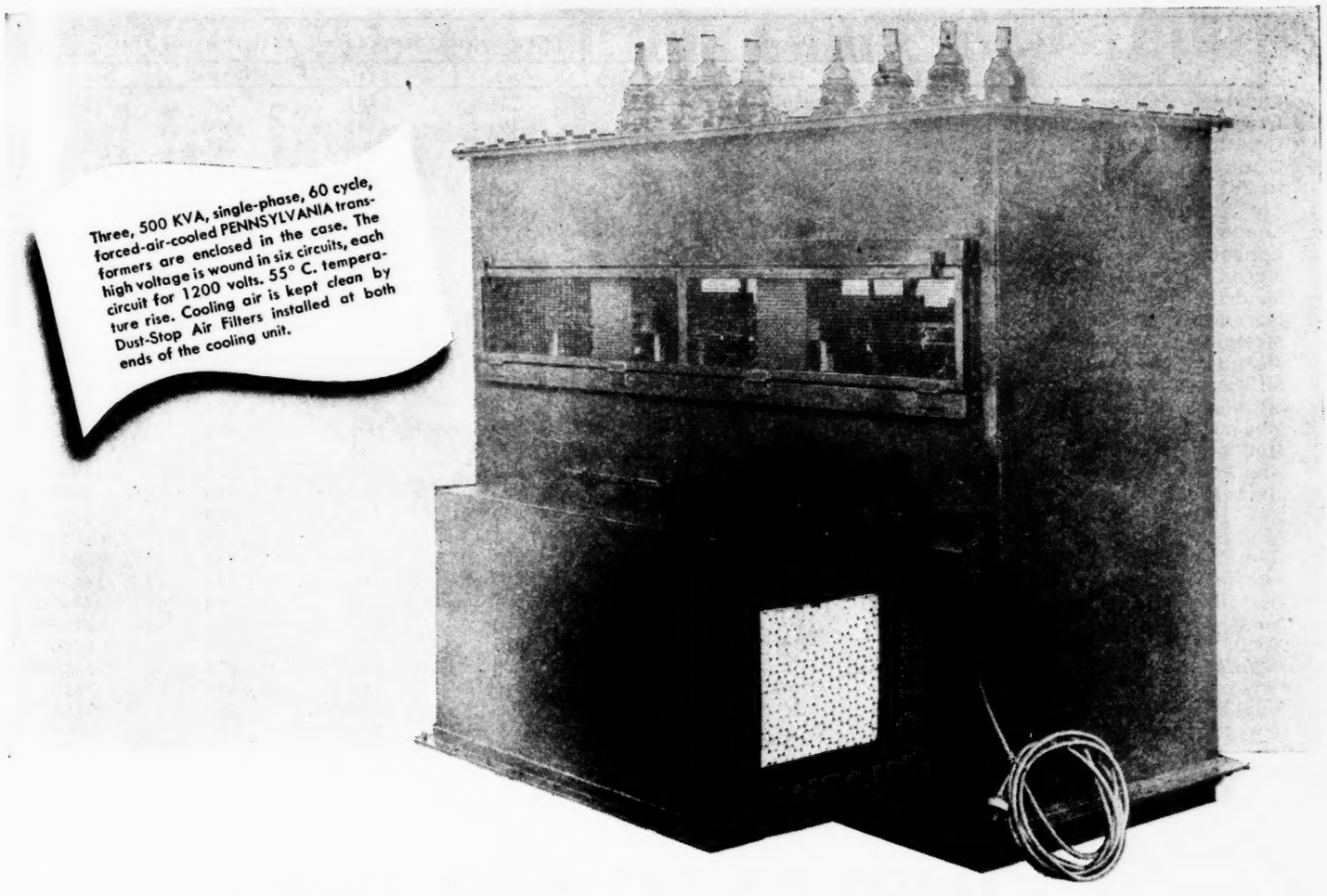
CITY	OCTOBER			CUMULATIVE, SEPTEMBER 1 TO OCTOBER 31			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Abilene, Texas	90	52	0	127	52	0	2061
Albany, New York	502	434	446	613	561	518	6580
Albuquerque, New Mexico	205	200	273	258	221	273	4298
Alpena, Michigan	579	548	570	831	768	792	8299*
Anaconda, Montana	495	413	647	893	720	982	8357**
Asheville, North Carolina	300	289	276	318	289	276	4232
Atlanta, Georgia	132	134	96	133	138	96	2890
Atlantic City, New Jersey	229	256	254	248	287	254	5176
Augusta, Georgia	81	71	16	81	71	16	2161
Baker, Oregon	449	342	552	777	559	810	7163
Baltimore, Maryland	206	246	223	225	273	223	4533
Billings, Montana	407	337	524	706	529	713	7119
Binghamton, New York	468	502	453	582	624	561	6808
Birmingham, Alabama	140	89	0	141	89	0	2352
Bismarck, North Dakota	574	463	626	904	696	848	9192
Block Island, Rhode Island	325	324	279	371	383	279	5788
Boise, Idaho	307	222	434	534	352	536	5552
Boston, Massachusetts	368	363	363	439	453	411	6045
Bozeman, Montana	499	456	651	885	737	987	8521**
Buffalo, New York	470	467	419	595	586	494	6822
Burlington, Vermont	565	579	481	736	752	625	7514
Butte, Montana	578	500	655	1024	844	999	8272
Cairo, Illinois	190	165	158	206	165	158	3909
Canton, New York	566	584	557	776	786	746	8020
Charles City, Iowa	481	432	476	702	564	569	7588
Charleston, South Carolina	45	46	0	45	46	0	1769
Charlotte, North Carolina	139	161	115	142	169	115	3120
Chattanooga, Tennessee	197	210	105	198	211	105	3118
Cheyenne, Wyoming	489	478	605	848	714	845	7466
Chicago, Illinois	362	373	350	465	450	350	5957
Cincinnati, Ohio	292	291	254	316	332	254	4684
Cleveland, Ohio	389	374	366	464	464	393	6155
Columbia, Missouri	280	203	260	350	235	260	4922
Columbia, South Carolina	88	94	31	88	97	31	2364
Columbus, Ohio	347	315	313	378	368	313	5398
Concord, New Hampshire	556	547	484	720	716	652	7353
Concordia, Kansas	264	209	276	375	255	276	5315
Dallas, Texas	75	30	0	93	30	0	2256
Davenport, Iowa	388	305	363	511	357	363	6289
Dayton, Ohio	408	342	273	455	396	273	5264
Denver, Colorado	315	306	428	534	393	500	5874
Des Moines, Iowa	350	284	357	474	354	357	6384
Detroit, Michigan	433	388	400	542	479	442	6490
Devils Lake, North Dakota	662	522	706	1052	797	982	9970
Dodge City, Kansas	254	231	276	372	288	276	5035
Dubuque, Iowa	435	370	409	596	453	445	6790
Duluth, Minnesota	654	556	626	998	835	896	9443
Eastport, Maine	559	560	543	798	782	819	8520**
Elkins, West Virginia	467	452	378	529	591	441	5697
El Paso, Texas	84	49	40	112	49	40	2428
Ely, Nevada	531	544	—	842	790	—	—
Erie, Pennsylvania	381	390	378	464	390	414	6273
Escanaba, Michigan	625	580	591	888	793	834	8771*
Evansville, Indiana	277	273	155	302	294	155	4244
Fort Smith, Arkansas	152	55	62	160	55	62	3147
Fort Wayne, Indiana	464	419	347	566	520	347	5925
Fort Worth, Texas	66	24	0	88	24	0	2148
Fresno, California	38	19	19	42	20	19	2334
Galveston, Texas	24	5	0	24	5	0	1016
Grand Junction, Colorado	279	206	369	370	212	369	5548
Grand Rapids, Michigan	462	418	419	612	518	476	6535
Green Bay, Wisconsin	562	497	505	784	660	637	7825
Greensboro, North Carolina	229	247	143	240	271	143	3529
Greenville, South Carolina	148	155	146	152	168	146	3380
Harrisburg, Pennsylvania	345	359	329	402	418	329	5375
Hartford, Connecticut	432	430	344	509	517	392	6036
Hatteras, North Carolina	55	73	0	55	74	0	2571
Havre, Montana	498	408	620	851	605	890	8700
Helena, Montana	486	505	614	865	773	865	7898
Houston, Texas	33	8	0	33	8	0	1157
Huron, South Dakota	462	454	526	702	612	649	8004
Indianapolis, Indiana	323	292	298	370	326	298	5298
Jackson, Miss.	97	75	—	97	75	—	—
*Kansas City, Missouri	253	145	219	315	168	219	4956
Kewanee, Illinois	282	305	334	351	346	412	6139
Knoxville, Tennessee	217	222	183	223	223	183	3670
La Crosse, Wisconsin	537	406	462	775	517	558	7322
Lander, Wyoming	482	521	654	847	770	930	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill., Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

(a) Data not available.

[Table concluded on page 120]



Three, 500 KVA, single-phase, 60 cycle, forced-air-cooled PENNSYLVANIA transformers are enclosed in the case. The high voltage is wound in six circuits, each circuit for 1200 volts. 55° C. temperature rise. Cooling air is kept clean by Dust-Stop Air Filters installed at both ends of the cooling unit.

NO DUST BLITZ FROM THE AIR FORCE

•This use of Dust-Stop* Air Filters by the Pennsylvania Transformer Company, to clean the air used in forced-air cooling, is another interesting example of the many ways in which engineers are adapting these efficient, economical air filters to their products.

Dust-Stops are used in thousands of similar applications, either designed by the equipment manufacturer or devised by the user to solve a particular dust control problem.

These standard, replaceable type Dust-Stop Air Filters have won the acceptance of leading heating, ventilating and air conditioning engineers. They are also installed in the conditioning systems of homes, industrial plants, commercial buildings, hotels and institutions throughout the country.

The Dust-Stop Air Filter is made of packs of glass fibers coated with an adhesive, faced with metal grilles and bound on the edges with a fiberboard frame. Dust-Stop's high efficiency is credited to the Fiberglas* filter medium and the nonodorous, nonevaporating adhesive which has extraordinary wetting power. Each particle of dust acts as a wick to carry adhesive to other particles. Filtering efficiency is thus maintained until the Dust-Stop becomes heavily coated—then it can be easily, quickly and inexpensively replaced.

Dust-Stops for central systems comprise individual parts for each cell; steel frames, bolts, nuts, gaskets and filters—complete and ready for assembly.

For complete information about Dust-Stops and their many uses write: *Owens-Corning Fiberglas Corp., 1912 Nicholas Building, Toledo 1, Ohio.*

In Canada, Fiberglas Canada Ltd., Oshawa, Ont.

DUSTOP AIR FILTERS

—a FIBERGLAS product

*T. M. REG. U. S. PAT. OFF.

Degree-Days for October, 1945 (Concluded)

HEATING AND VENTILATING'S 10TH YEAR OF PUBLICATION OF MONTHLY DEGREE-DAY DATA

CITY	OCTOBER			CUMULATIVE, SEPTEMBER 1 TO OCTOBER 31			HEATING SEASON[1]
	1945	1944	NORMAL	1945	1944	NORMAL	NORMAL
Lansing, Michigan	531	507	481	711	661	595	7048
Lewiston, Maine	599	556	501	794	742	666	7707
Lincoln, Nebraska	287	243	316	399	300	316	5999
Little Rock, Arkansas	144	87	47	157	87	47	2811
Livingston, Montana	441	439	523	802	747	750	7205
Los Angeles, California	27	34	0	29	39	0	1504
Louisville, Kentucky	238	229	186	250	245	186	4180
Lynchburg, Virginia	251	280	220	266	317	220	3980
Macon, Georgia	(a)	94	6	(a)	94	6	2201
Madison, Wisconsin	496	431	459	683	542	546	7429
Marquette, Michigan	608	525	567	889	769	567	8693*
Memphis, Tennessee	161	140	62	172	140	62	2950
Meridian, Mississippi	94	99	22	94	99	22	2160
Milwaukee, Wisconsin	440	430	450	610	512	534	7245
Minneapolis, Minnesota	506	431	481	733	565	574	7850
Modena, Utah	410	431	517	588	532	673	6562
Montgomery, Alabama	67	55	0	67	55	0	1884
Nantucket, Massachusetts	325	322	335	381	381	398	5957
Nashville, Tennessee	217	208	136	224	209	136	3507
New Haven, Connecticut	387	391	360	451	466	399	5895
New Orleans, Louisiana	12	13	0	12	13	0	1024
New York, New York	276	283	276	309	318	276	5347
†Nome, Alaska	660	742	744	660	742	744	14580**
Norfolk, Virginia	107	131	99	107	136	99	3350
North Head, Washington	405	245	366	693	469	621	5452**
North Platte, Nebraska	316	333	434	513	427	476	6366
Oakland, California	148	122	183	223	219	273	3143**
Oklahoma City, Oklahoma	130	75	105	175	85	105	3613
Omaha, Nebraska	315	258	329	431	320	329	6131
Oswego, New York	455	474	459	589	607	573	7088
Parkersburg, West Virginia	305	321	285	339	379	285	4775
Peoria, Illinois	418	338	381	520	407	384	6109
Philadelphia, Pennsylvania	245	254	242	276	285	242	4855
Phoenix, Arizona	2	0	0	2	0	0	1405
Pittsburgh, Pennsylvania	340	322	313	402	386	313	5235
Pocatello, Idaho	397	397	499	704	600	655	6655
Portland, Maine	593	542	477	771	734	639	7218
Portland, Oregon	288	201	332	399	281	437	4469
Providence, Rhode Island	352	331	348	412	392	411	6015
Pueblo, Colorado	315	333	388	491	400	394	5514
Raleigh, North Carolina	154	182	130	154	187	130	3234
Rapid City, South Dakota	416	384	515	701	533	659	7118
Reading, Pennsylvania	312	334	344	356	384	344	5389
Red Bluff, California	54	27	—	59	29	—	—
Reno, Nevada	353	380	453	548	529	597	5892
Richmond, Virginia	193	213	161	196	229	161	3695
Rochester, New York	467	491	431	605	625	503	6732
Roseburg, Oregon	287	185	350	393	258	461	4428
Roswell, New Mexico	179	138	186	237	157	186	3484
Sacramento, California	42	31	71	55	34	71	2653
St. Joseph, Missouri	287	172	248	369	208	248	5161
St. Louis, Missouri	223	173	205	270	190	205	4585
Salt Lake City, Utah	307	214	388	518	281	406	5555
San Antonio, Texas	54	16	0	59	16	0	1202
San Diego, California	12	25	34	13	31	34	1645
Sandusky, Ohio	368	350	353	429	421	353	6208
San Francisco, California	121	127	146	233	276	260	3264**
Sault Ste. Marie, Michigan	669	658	623	1023	939	899	9285**
Savannah, Georgia	46	35	0	46	35	0	1490
Scranton, Pennsylvania	434	467	397	517	574	457	6129
Seattle, Washington	313	231	394	484	324	580	4934**
Sheridan, Wyoming	432	356	636	744	565	900	8008
Shreveport, Louisiana	81	58	0	81	58	0	1933
Sioux City, Iowa	392	352	415	584	469	448	6898
Spokane, Washington	440	331	515	706	483	707	6355
Springfield, Illinois	282	228	282	348	258	282	5373
Springfield, Missouri	262	193	217	317	222	217	4428
Syracuse, New York	467	484	425	601	619	521	6893
Tacoma, Washington	377	286	400	614	413	607	5181**
Terre Haute, Indiana	307	272	233	351	307	233	4872
Toledo, Ohio	452	420	369	544	523	378	6077
Topeka, Kansas	246	149	236	317	175	236	4969
Trenton, New Jersey	306	323	242	350	372	242	4933
Utica, New York	548	554	430	679	705	612	6796
Valentine, Nebraska	386	420	490	637	564	583	7039
Walla Walla, Washington	252	185	332	338	250	332	4808
Washington, D. C.	240	280	251	256	304	251	4626
Wichita, Kansas	227	143	192	292	173	192	4673
Williston, North Dakota	573	441	660	977	682	930	9323
Winnemucca, Nevada	380	336	507	623	502	699	6427**
Yakima, Washington	315	191	437	451	270	557	5599

†Nome data are for September.
(a) Data not available.

*Includes August.
**Includes July and August.

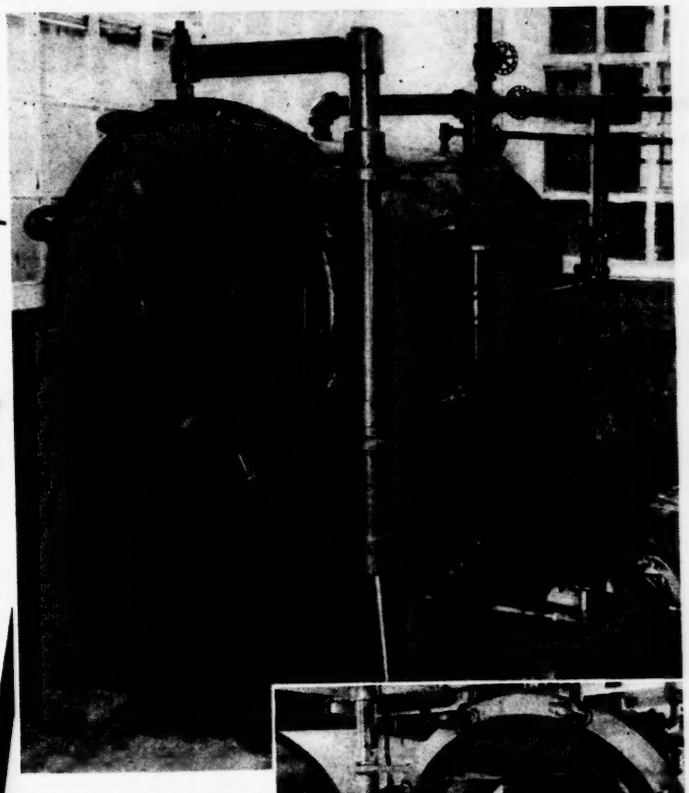
[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

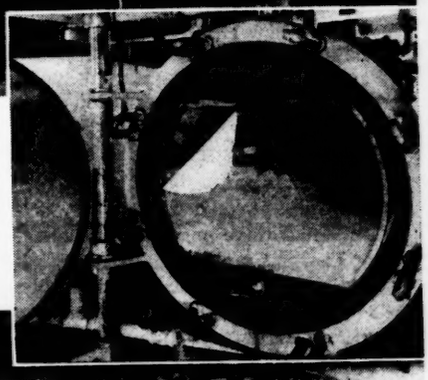
Removes ALL OIL from condensed returns used for boiler feed

The REFINER

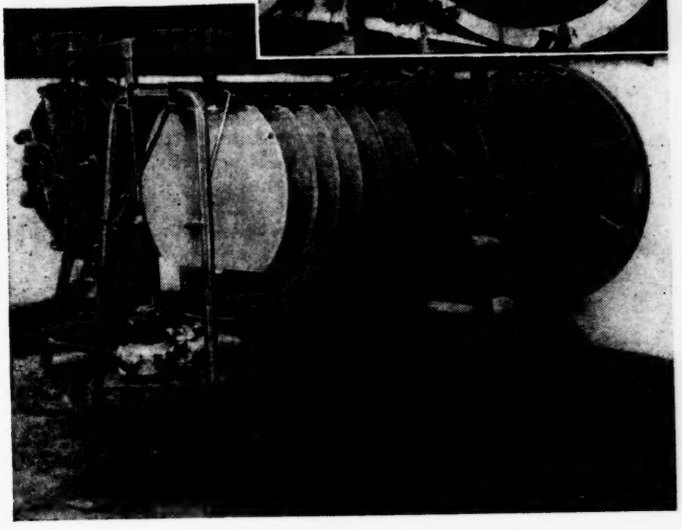
A revolutionary new filter PROVEN IN SERVICE

1. Eliminates oil entering boilers. Improves boiler efficiency. Reduces boiler maintenance costs.
2. Saves heat units and fresh water by clarifying contaminated returns formerly dumped.
3. Removes free and EMULSIFIED oil from water to less than one-tenth part per million.
4. Requires no chemicals or wasteful back-washing.
5. Is simple, inexpensive to operate.
6. Requires little space.





Upper picture shows the Refiner with special quick-locking door in place. Door open at right. Note how filter bed peels easily from pressure leaves in one piece.



Showing cleaning rack and waste receptacle with leaves withdrawn for cleaning.

THE REFINER is an outstanding achievement in filters designed for extremely fine filtration. It breaks the tightest emulsion in condensate and removes both emulsified and free oil from an oil content as high as 90 parts per million down to a guaranteed maximum of one-tenth ppm. The REFINER features compactness and low-cost operation. Flow rates of 20 to 200 gpm are obtained in single units. A battery of units provide greater capacities. The cost of filtered liquid by this new method of emulsion breaking is extremely low. No back-wash water is used. The REFINER will greatly step up the efficiency of your plant and reduce boiler maintenance costs. Engineering assistance will be furnished gladly.

Write for Catalog

APPLICATIONS

The REFINER can be used as a polishing filter for practically any liquid, including boiler feed water and condensate, alcoholic, malt and other beverages, chemicals, aromatics, paints, varnishes, lacquers, soaps, detergents, juices and liquid foods, and liquids used in processing other substances. The pressure-tight cylinder permits filtration of volatile, inflammable, and hazardous liquids. It also removes turbid matter of the same specific gravity as the liquid.

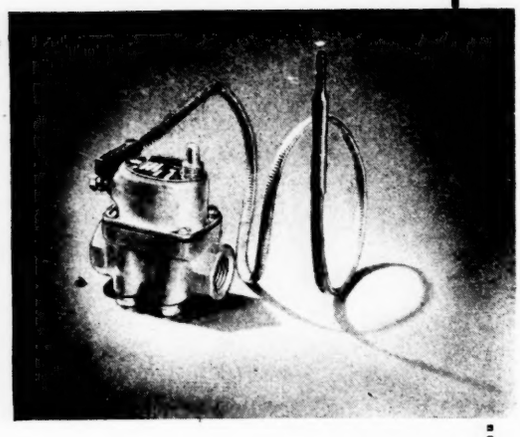
BLACKBURN-SMITH MANUFACTURING COMPANY, INC.

For 60 years designers and manufacturers of filters

94 River Street, Hoboken, N. J.

Blackburn-Smith Mfg. Co. is a wholly owned subsidiary of Condenser Service & Engineering Co., Inc., builders of Steam Condensers, Steam Jet Air Ejectors, Evaporators, Stage Heaters, Gas Coolers, Drain Coolers and Heaters, Aftercoolers, Air Preheaters, Fuel Oil Heaters, Jacket Water Coolers, Process Heat Exchangers, Transformer Oil Coolers, Generator Air Coolers, Lubricating Oil Coolers, Storage Tank Oil Heaters, Feed Water Heaters, Distillers, Industrial and Oil Refinery Heat Exchangers, and other types of heat exchange equipment.

New MR-2 SAFETY THERMOVALVE



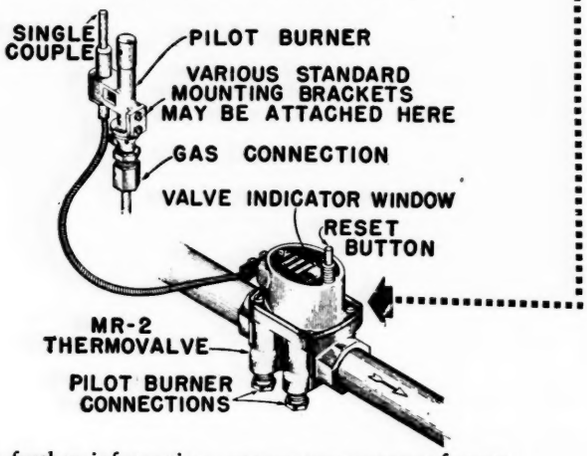
THIS new electro magnetic thermovalve assures unfailing safety in gas control applications. Used on space and unit heaters, central and floor furnaces, water and range heaters, hot water and steam boilers. Handles manufactured, natural or LP-Gases.

Check these outstanding features:

- Streamlined design.
- High-flow capacities.
- Visual valve position indicator.
- Design simplicity.
- Sealed electro magnetic assembly.
- Heavy duty 5/16 round thermocouple.
- Flexible armored cable leads.

On the diagram below, the new MR-2 valve and the new 26-R Pilot Burner are used for out-pilot safety control. No outside current is required. Valve holds open until released by pilot-flame failure. 100% gas shut-off will be maintained until pilot light is reignited and valve manually reset by push button.

MR-2 INSTALLATION



For further information, contact your nearest factory branch or distributor, or write for Catalog 52-B and Manual FI-101.

GENERAL CONTROLS
801 ALLEN AVENUE GLENDALE 1, CALIF.

FACTORY BRANCHES: PHILADELPHIA • ATLANTA • BOSTON • CHICAGO • DALLAS KANSAS CITY • NEW YORK • DENVER • DETROIT • CLEVELAND • PITTSBURGH HOUSTON • SEATTLE • SAN FRANCISCO • DISTRIBUTORS IN PRINCIPAL CITIES

Getting Personal

K. Steiner

K. Steiner *(Underfeed Stokers,* page 73) was born in New York City, raised in Chicago, attended Armour (now Illinois) Institue of Technology, where he received a degree of Chemical Engineer. For 18 years he has been engaged in the design, production and application of fuel burning equipment. He is the author of numerous articles and three books on fuels, the latest (now in press) presenting the technology of coal, oil and gas fuels and burners. From 1942 to 1945 he served as industrial production engineer for the Army Ordnance Department.

Mr. Steiner is now consulting engineer for C. Hoffberger Co., Baltimore. He is a registered professional mechanical and chemical engineer, member of A.S.M.E., A.S.T..M. and Army Ordnance Association.

Leslie Silverman

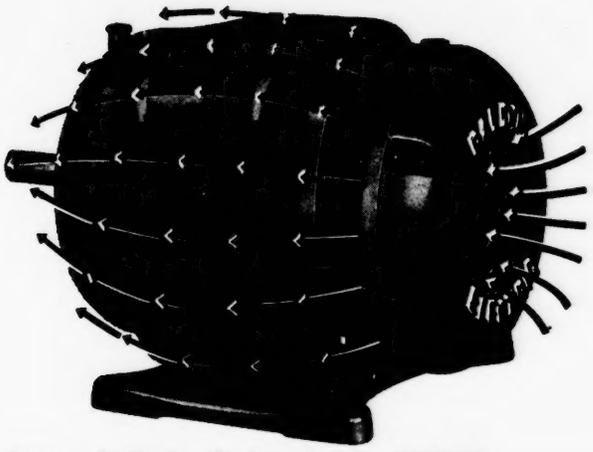
Leslie Silverman *(Air Cleaners for Internal Combustion Engines,* page 85) was born in Chicago and received a B. S. in mechanical engineering from the University of Illinois. He received a master's degree in mechanical engineering from Rutgers University and a master's and doctor's degree in engineering from Harvard University. After a year of teaching and research at Rutgers he has been at Harvard. At the present time he is assistant professor of industrial hygiene, teaching graduate students and doing research and consulting work on industrial ventilation, air analysis and industrial hygiene. During the war, Dr. Silverman has been working for the OSRD on research and development for the War and Navy Departments. He is the author of several papers and reports and is a member of Sigma Xi, Tau Beta Pi, A.S.M.E., A.I.H.A. and A.A.A.S.

George Th. Lang

George Th. Lang *(Evaporative Cooling for Textile Mills,* page 89) was born in Budapest, Hungary, and received his M.E. from the Technical University of Budapest in 1934. He joined Messrs. Ganz & Co., Ltd., Budapest, where he designed air conditioning equipment for railway cars. His hobby became the heat pump, and he believes he is the first to apply this particular type of equipment to the heating and cooling of railway cars. He is convinced that this is the best system for railway car air conditioning. In 1939, Messrs. Ganz sent him to the Argentine to supervise installation and service of air conditioning equipment for a number of rail cars they had supplied for the Argentine State Railways. In 1941 he took charge of the newly created air conditioning department of ASSA Ltda., manufacturing contractors and representatives of Frick Co. of Waynesboro, Pa. In this position he had an opportunity to install, besides a large number of conventional installations, quite a number of the heat pump type.

THE MOTOR for MANY APPLICATIONS

It's the BALDOR STREAMCOOLED MOTOR



Arrows indicate air travel over ENTIRE EXTERIOR of Baldor Streamcooled motor.

This ALL-PURPOSE MOTOR will simplify your Designing, Purchasing, Production and Inventory. Check these features with your motor specifications:

1. Totally enclosed — ball bearing.
2. Drip-proof; splash-proof; grit-proof; lint-proof.
3. Horizontal, vertical and side wall mounting.
4. Removable base.
5. End plates interchangeable for face mounting.
6. Standard NEMA dimensions.
7. Standard or glass insulation.

BALDOR ELECTRIC COMPANY, St. Louis 10, Mo.

District Offices in Principal Cities

PLAN YOUR POST-WAR MOTOR REQUIREMENTS *Now.* Get the Latest BALDOR Bulletins

AIR CONDITIONING NOZZLES

Nozzles of unique Yarway Involute Design.

No internal parts or vanes to clog or erode.

Insure trouble-free air washing service.

Sizes and types for all requirements.

Many large users—installations total more than 5 million gallons per minute in water cooling and air conditioning service. Write for Bulletin N-615.

YARNALL-WARING COMPANY
104 Mermaid Avenue
PHILADELPHIA

YARWAY

Alnor VELOMETER

★ all purpose air velocity meter

Instantaneous, direct readings of air speed measured in feet per minute with the *Alnor* Velometer give you the quick, accurate information on air movement needed to check operation of blowers, fans, air conditioning installations, and similar equipment. No calculations, no timing, no conversion tables; read velocities direct from the Velometer scale. Extension jets permit accurate readings in many locations that would be completely inaccessible with other means of measurement.

The Velometer is made in several standard ranges from 20 fpm to 6,000 fpm, and up to 3 inches static or total pressure. Special ranges available as low as 10 fpm and up to 25,000 fpm velocity and 20 inches pressure.

Write for Bulletin No. 2448-E.

Illinois Testing Laboratories, Inc.

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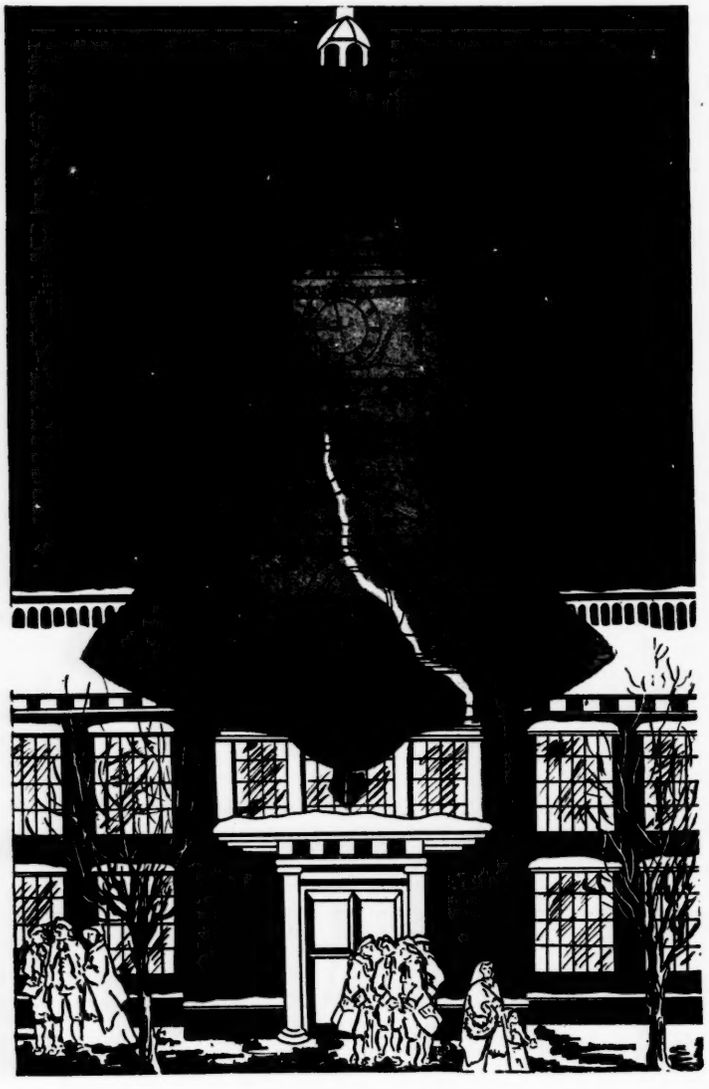


Yuletide Spirit

Independence of thought,
Independence of creed,
These are the symbols
Of freedom's seed.

These give the world a united lease
To Holy Day joy and eternal peace.

Plant: Wheatland, Mercer County, Pa.
General Offices: Real Estate Trust Building
Philadelphia 7, Pa.

WHEATLAND TUBE COMPANY

INDUSTRIAL DEGREE-DAYS
September and October, 1945

City	Number of Industrial Degree Days			
	55F Base		45F Base	
	September	October	September	October
Baltimore, Md.	26	36	0	0
Buffalo, N. Y.	26	189	0	29
Chicago, Ill.	11	109	0	4
Cleveland, Ohio	6	137	0	9
Detroit, Mich.	17	158	1	20
Indianapolis, Ind.	3	93	0	3
New York, N. Y.	3	276	0	69
Philadelphia, Pa.	3	54	0	1
Pittsburgh, Pa.	5	106	0	4
St. Louis, Mo.	6	49	0	0

Canadian Degree-Days for September and October, 1945*

City	September		October	
	1945	Normal	1945	Normal
Calgary, Alta.	492	432	670	722
Charlottetown, P. E. I.	189	222	552	539
Crescent Valley, B. C.	412	360	636	698
Edmonton, Alta.	480	417	747	747
Fort William, Ont.	417	354	794	722
Grande Prairie, Alta.	477	480	772	812
Halifax, N. S.	163	189	504	499
London, Ont.	181	126	577	508
Medicine Hat, Alta.	398	267	577	601
Moncton, N. B.	258	282	651	595
Montreal, P. Q.	187	180	574	561
North Bay, Ont.	368	264	753	694
Ottawa, Ont.	244	204	598	595
Penticton, B. C.	281	213	570	527
Porquis Junction, Ont.	445	396	871	800
Prince George, B. C.	504	444	769	741
Quebec City, P. Q.	230	276	663	651
Regina, Sask.	489	408	769	794
St. John, N. B.	244	270	570	558
Saskatoon, Sask.	507	396	756	781
Toronto, Ont.	164	168	524	504
Vancouver, B. C.	288	234	459	459
Victoria, B. C.	270	264	388	446
Windsor, Ont.	117	54	477	425
Winnipeg, Man.	413	330	747	744

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

. . . Since the Last Issue

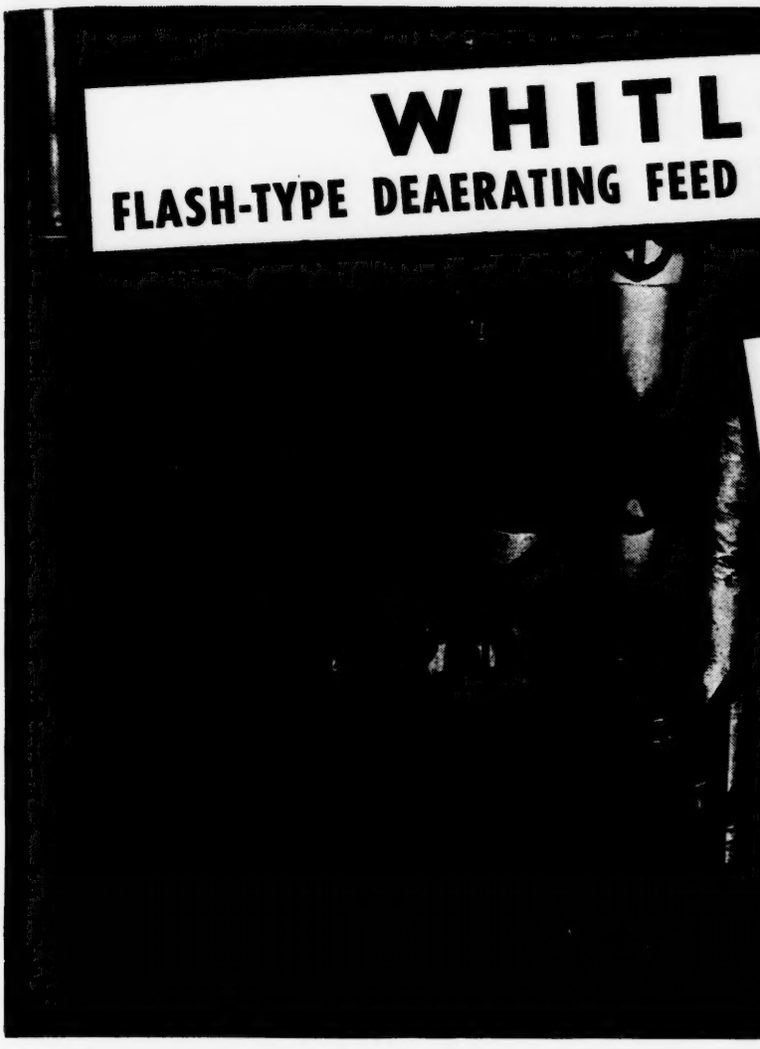
Elroy Payne, president of **Payne Furnace Co.**, Beverly Hills, California—one of the Dresser Industries—announced the appointment of **Charles F. Cushing**, as vice-president and assistant general manager. Mr. Cushing leaves the post of distribution manager of Bryant Heater Co., another Dresser member company, with whom he has been associated since 1935. Prior to joining Bryant, Cushing was connected with Frigidaire Corp. and Davison Chemical Corp.

A graduate of Johns Hopkins, he is a member of the ASHVE. and the Advertising and Sales Executives Clubs of Cleveland.

Mr. Raymond S. Doherty has resumed his position as New York sales manager of **Taco Heaters, Inc.** after a forty-two months' absence as an officer in the Army of the United States.

The Seattle branch of **Fairbanks, Morse & Co.** has announced that the **Milwaukee Machinery Co.** of Portland, Oregon, has been appointed exclusive distributor for the complete line of Fairbanks-Morse turbine pumps.

WHITLOCK
FLASH-TYPE DEAERATING FEED WATER HEATING SYSTEM



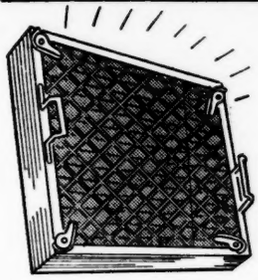
The Whitlock Flash-type Deaerating Feed Water Heating System for reducing gas inclusions has been designed for proper deaeration. The system utilizes bleed or exhaust steam and the amount of flash or "boil-off" can be varied. Normal oxygen concentrations consume iron very rapidly and the Whitlock system soon pays for itself by preventing the corrosion of boiler tubes, carrying lines, and other equipment.

Flexibility, easy maintenance and ability to accept steam at various points at different pressures make the Whitlock system . . . with simple construction and no internal complexities . . . the optimum equipment for boilers up to 2000 HP. Let our engineer analyze your requirements.

Write for Bulletin 645 covering Whitlock Power Plant Equipment.

THE WHITLOCK MANUFACTURING CO.
40 SOUTH STREET, ELMWOOD, HARTFORD 1, CONN.
New York, Boston, Chicago, Philadelphia, Detroit, Richmond

In Canada: Darling Brothers, Ltd., Montreal



Easier Way to Clean Air Filters

Efficiency of air conditioning units is largely dependent on periodic cleaning of air filters . . . regular, complete removal of deposits entrapped from the air is necessary to maintain high filtering capacity.

If your filters are of the dry or viscous impingement washable type, you can clean them easily and effectively by using Oakite materials specially designed for this work. Dirt, dust, soot, lint, pollen and other foreign matter collected on surfaces are thoroughly removed . . . full filtering capacity is quickly restored . . . equipment out-of-service time is reduced to a minimum.

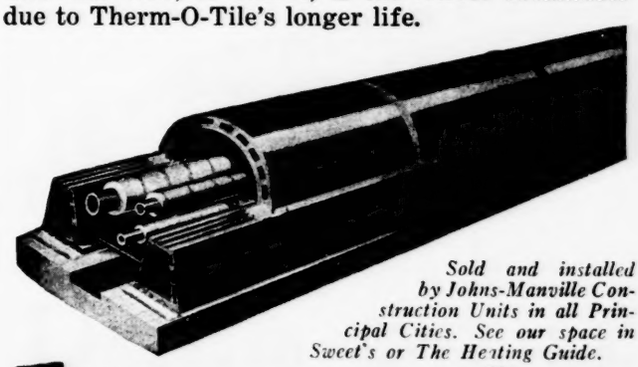
Dependable Oakite materials and techniques are available for expediting other essential air conditioning maintenance jobs. Write us concerning your problems. There's no obligation.

OAKITE PRODUCTS, INC., 58A Thames St., NEW YORK 6, N. Y.
Technical Service Representatives in All Principal Cities of the United States and Canada

OAKITE MATERIALS METHODS SERVICE — Keep Buying Bonds — **CLEANING** FOR EVERY CLEANING REQUIREMENT

How much does it COST?

Don't be frightened into thinking that the first cost of Therm-O-Tile is high because of its assured *permanence*, greater efficiency, and superior strength. The first cost is nevertheless *competitive*. The final cost, of course, is the *lowest obtainable* due to Therm-O-Tile's longer life.



Sold and installed by Johns-Manville Construction Units in all Principal Cities. See our space in Sweet's or The Heating Guide.

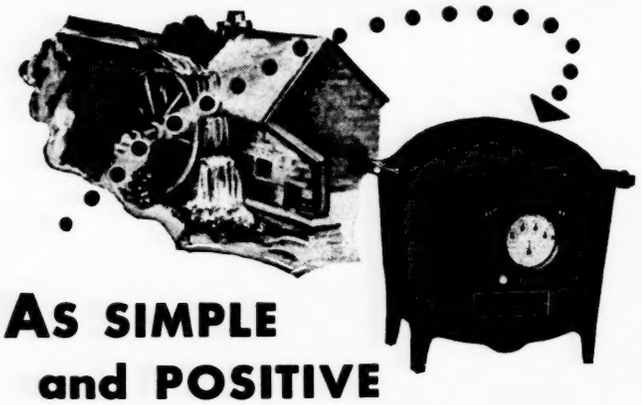
THERM-O-TILE
Reg. U. S. Pat. Off.

Permanent Underground Pipe Conduit

H. W. PORTER & CO., Inc.
823-V Frelinghuysen Ave., Newark 5, New Jersey

Without obligating us in any way, ☐ Please send Bulletin 381. ☐ Send representative. ☐ Enclosed is a sketch, with principal data of a prospective underground piping job, on which we shall be glad to have your ☐ comments, ☐ quotations.

Clip your name, firm, and address to this ad; tear out with the checked squares above; mail; and you will hear from us promptly.



AS SIMPLE and POSITIVE as a water wheel

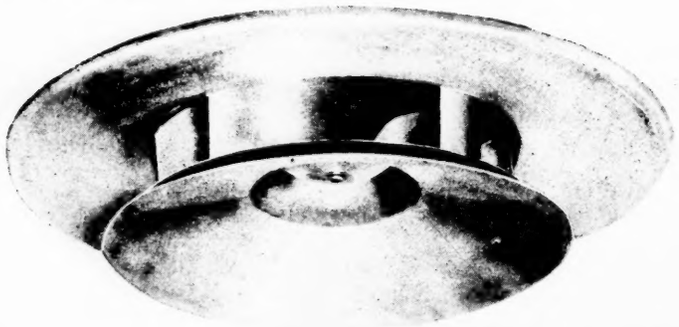
That's the reason for the LOW COST and ACCURACY of the ADSCO Rotary Condensation Meter

Wherever it is possible to collect the condensate from heating or processing lines, there's no need to waste fuel because these low priced meters detect steam losses and are as positive as a water wheel — so accurate that the slightest trickle of condensate is recorded on direct reading counters.

Tell us the maximum pounds of condensate per hour or the square feet of equivalent direct radiation in the building or department to be metered and we will tell you how surprisingly little it will cost to put your steam consumption on a sound accounting basis. Ask for Bulletin 35-80HV.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, NEW YORK
Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

DEMUTH
Draftless
AIR DISTRIBUTOR . . . .



The only Distributor with the patented curved-vane construction which imparts a circulator motion to the air . . . the Distributor which effectively mixes room air with conditioned air . . . the Distributor which speedily establishes a uniform temperature WITHOUT DRAFT!

Quick Deliveries of STAINLESS STEEL ALUMINUM GALVANIZED IRON OR ENAMELED AIR DISTRIBUTORS

CHARLES DEMUTH & SONS
MINEOLA (LONG ISLAND), N. Y.

John A. Johnson is back with **The Mercoid Corp.**, at his old job as sales engineer, in the New England territory. He is located at 89 Chester Road, Belmont, Mass.

Bryant Heater Co., Cleveland, Ohio, long a prominent producer of domestic gas heating equipment, announces the establishment of an Industrial Division to handle the development and distribution of gas combustion components for industrial and process equipment.

Activity in the division, which is intended to round out the Bryant position in the gas industry, is centered on the development of an improved line of mixers, injectors, burners and specialized items of gas combustion equipment.

D. A. Campbell

Initial products are announced as being a new proportional mixer (Bryant Flomixer); high and low pressure injectors (Hijectors and Lojectors); tunnel burners, combustion blowers, and opentype burners and cages.

Basic design work on a number of the new products is nearing completion and volume production of certain parts will be reached by the first of the year.

The Industrial Division is under the direction of **Donald A. Campbell**, who has specialized in gas and combustion engineering since his graduation from the Engineering School of the University of Colorado in 1916.

Formal organization of the **Pittsburgh Consolidation Coal Co.** was completed last month by the 15-man board of directors headed by **Robert C. Hill** of New York, chairman. **George H. Love** of Pittsburgh, president, named **A. K. Oliver** chairman of the finance committee, **James B. Morrow** first vice-president, **George W. Kratz** vice-president, and **C. E. Beachley** secretary and treasurer. The new company is a merger of the Pittsburgh Coal Co. and the Consolidation Coal Co. with combined assets of over $100 million and working capital of about $29 million. Operations will be carried on by two wholly owned subsidiaries bearing the names of the two original merging companies. The aim of the merger, Mr. Love said, will be to have a well financed, aggressive unit which will fight to restore coal as an undisputed primary source of energy.

At the annual stockholders' meeting of **The H. B. Smith Co., Inc.**, and at the subsequent directors' meeting, a number of promotions and other changes were

S. K. Smith

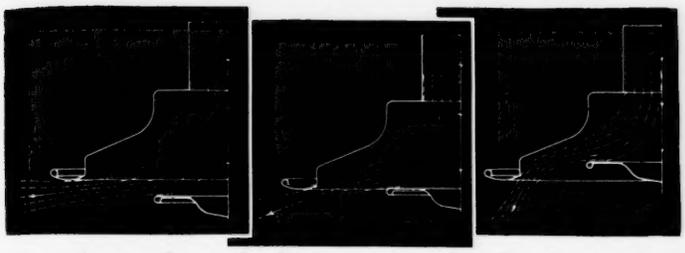
F. A. Ferguson

made in the officers and directors of the company, although all the officers have been connected with the company for a number of years. **Henry S. Washburn** is

How *adjustable* air diffusers increase the efficiency of supply air diffusion.

Better mixing of room and supply air, more uniform temperatures throughout the occupied zone and noiseless, draftless air diffusion are accomplished with

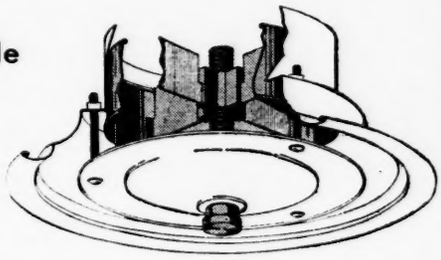
KNO-DRAFT *adjustable* Diffusers



Any desired angle from vertical to horizontal at your fingertip.

By simply turning the air adjustment screws (easily accessible from under the unit) the inner cone of any KNO-DRAFT Diffuser may be raised or lowered to secure any angle of air direction required by ceiling heights, system balancing, and individual or seasonal requirements. Thus the diffuser becomes more effective whether it is used in cooling, heating, ventilating, or combined systems, because it can expel chilled air parallel to the ceiling or eject heated air downward to prevent stratification.

Type K Adjustable Diffuser with Type D Volume Damper.



Pat. and pat. pending

Any desired volume at your fingertip

Every KNO-DRAFT Diffuser can be equipped with a built-in volume damper (easily adjusted by hand-turning knob under diffuser) which varies the outlet aperture uniformly without affecting the outlet velocity or diffusion pattern.

Thus KNO-DRAFT Diffusers can be adjusted quickly and accurately to the angle and volume needed to meet a wide variety of conditions, and as a result, the factors of temperature variation, temperature fluctuation, drafts and noise can be minimized considerably.

The W. B. Connor Engineering Corp. maintains a staff of specialists and district representatives in leading cities to assist you with any air distribution problem.

FREE HANDBOOK

Contains clear sketches, charts, dimension prints and instructive text that simplify the selection and installation of air diffusers.

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Air Diffusion *Air Purification* *Air Recovery*

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WB CONNOR ENGINEERING CORP

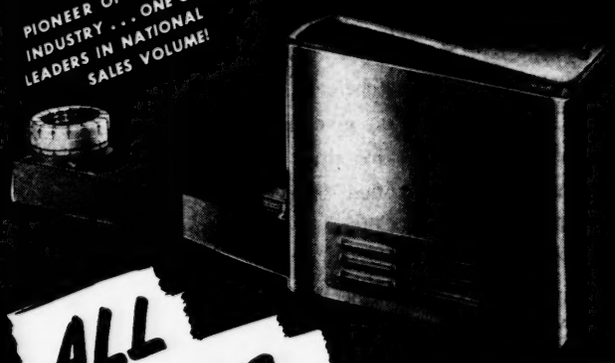
You want the best

TO SELL THE MOST!

FREEMAN STOKERS

FIRST CHOICE OF AMERICA'S FOREMOST HEATING ENGINEERS

PIONEER OF THE STOKER INDUSTRY . . . ONE OF THE LEADERS IN NATIONAL SALES VOLUME!



ALL SIZES NOW AVAILABLE

FREEMAN STOKER DIVISION
ILLINOIS IRON & BOLT CO.
918 S. MICHIGAN AVE., CHICAGO 5, ILLINOIS

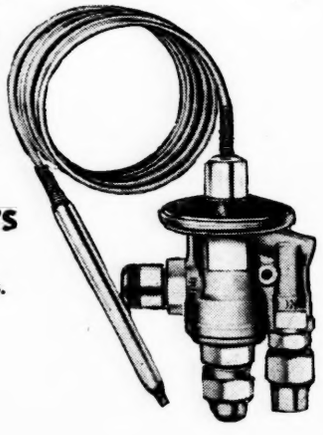
"FRACTIONAL TONNAGE
A-P VALVES FIT LOW
TEMPERATURE WORK
WITHOUT HUNTING
OR STARVING...!"
REFRIGERATION MAINTENANCE CO.
We use and like A-P Valves especially on low temperature work. We like the fractional tonnage sizes because we can better fit the job without hunting or starving.
Yours very truly,
A. L. Robertson

EXPERIENCED REFRIGERATION SERVICE

Engineers like Mr. A. L. Robertson, of the Refrigeration Maintenance Co., Madison, Wis., give full credit to "A-P Dependable" Refrigerant Valves for their special adaptation to low temperature work. They find that "A-P" fractional tonnage sizes for Freon or Methyl Chloride refrigerant applications make it easier, as Mr. Robertson states, to fit the job without necessity of "hunting" or "starving" the line.

The underlying reason for the wide range of adaptability of A-P Refrigerant Valves is directly traceable to A-P testing practices. For every valve leaving the A-P factory has been tested again and again, and then precision-regulated to do its work without need for field adjusting. That means a lot to every practical refrigeration service engineer!

Write for Illustrated Bulletins covering A-P Refrigerant Valves



AUTOMATIC PRODUCTS COMPANY
2462 N. 32nd St., Milwaukee 10, Wis.
Export Dept., 13 E. 40th St.
New York 16, N. Y.

DEPENDABLE *Refrigerant Valves*

A-P Model 205 Thermostater Expansion Valve. Capacity up to 1 ton Freon.

Stocked and Sold by Good Refrigeration Jobbers Everywhere—
Recommended and Installed by Leading Refrigeration Service Engineers

now chairman of the board of directors. Mr. Washburn, who became associated with the company in 1938 as president, is also president of the Foster Machine Co. and the Plainville Casting Co. He attended Yale, is a past president of the American Foundrymen's Association, has served on W.P.B. Iron and Steel Industry Advisory Committee during the war and is a noted authority on gray iron foundry practice and cost. **Stanley K. Smith,** new president, has been identified with the company continuously for the 30 years since 1915 except for two years, World War I. He has been at various times assistant secretary, secretary, assistant treasurer, treasurer and vice-president. Mr. Smith, who attended Sheffield Scientific School at Yale (also B.A. Yale 1914), and has headed up H. B. Smith technical and research activities, is currently chairman of the research committee of the Institute of Boiler and Radiator manufacturers. **Franklin A. Ferguson,** a graduate of Yale, Sheffield Scientific School 1912, became associated with H. B. Smith in 1928 as plant superintendent after extensive experience in foundry management. He is now vice-president, general manager, and a director of the corporation. **George W. Roraback,** who attended Worcester Tech, joined the organization in 1919. He has since come up through the ranks in engineering, as assistant purchasing agent, production planning, later as purchasing agent and manager of products distribution. He is now vice-president, manager of production, and a director. **A. Lionel Lawrence** attended the University of Wisconsin and was formerly associated with The Federal Reserve Bank of Boston. He joined the company as vice-president in 1938 and has been treasurer since 1940. He is a director of the corporation. **John E. Reed,** who also attended Yale, has been with the company since 1934 and who was formerly assistant secretary, is now secretary. Mr. Reed graduated from Northeastern University Law School in 1942 and was admitted to the Massachusetts Bar at that time. He has served as assistant sales manager for Westfield Branch, and advertising manager. **Sidney T. Dorrington** has been recently elected assistant treasurer and assistant secretary. Joining the organization in 1923, he has been identified with the accounting department in various capacities and now is in charge of this important work. **William C. Murray** of Utica, N. Y., who has been a director of the company since 1938, continues in that capacity. **Coll T. Flint,** known from Presque Isle, Maine to Providence, R. I. as sales manager of Smith's Boston Branch territory and affiliated with the company since 1911, has recently been elected a director.

Robert M. Hatfield has resigned as deputy vice-chairman of the War Production Board to become assistant general sales manager of **Combustion Engineering Co.** A mechanical engineering graduate of Purdue University, Class of 1932, Mr. Hatfield came with Combustion Engineering Co. in 1934 as a student engineer, subsequently serving in the service and erection department, the proposition department and then as sales engineer in the Cleveland office. In 1942 he went to Washington as chief of the Boiler Section of the Power Branch WPB, under J. E. Krug and later became director of the Production Scheduling Division. He resigned from WPB in May 1944 to accept a commission in the Navy, and in November of that year was assigned back to WPB to take charge of the Navy repair parts program. Last April he was placed on inactive status by the Navy to become Deputy Vice-Chairman for Production of WPB which position he held until the War Production Board was abolished on November 2, 1945. Mr. Hatfield is a member of the A.S.M.E. and a registered Professional Engineer in the State of Ohio.

R. M. Hatfield

BEND PIPE COLD

quickly . . . on the job!

Make on-the-job bends . . . in *cold* pipe . . . with a one-man-operated GREENLEE Hydraulic Pipe Bender. Quickly solve problems of installing pipe in hard-to-reach spots and around obstructions.

The GREENLEE makes accurate, uniform bends in just a few minutes . . . in pipe up to 4½-inch! Compact, portable, easy to carry from job to job . . . easy to set up and operate.

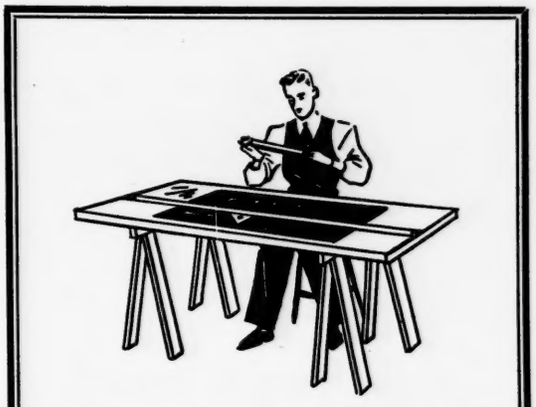
Save on fittings, manufactured bends, their threading and installing. And in *time-savings* alone, the GREENLEE rapidly pays for itself . . . lets you move on to more new jobs.

Get complete information today on GREENLEE Hydraulic and Hand Benders. Write for free Booklet S-116. Greenlee Tool Co., Division of Greenlee Bros. & Co., 2332 Twelfth Street, Rockford, Illinois.

REGISTERED TOOLS

GREENLEE

FOR THE CRAFTSMAN



"Always at your Service"

With a background of more than 25 years practical experience in solving difficult refrigeration problems as they have arisen in the field — our engineering department is competent, ready and anxious to be of help to you on any refrigeration problem at any time. Write, wire, or phone.

Experienced Acme representatives in principal cities are glad to render personal help whenever possible. See your telephone book for his address.

ACME PRODUCTS — Evaporative Condensers • Forced Convection Units • Ammonia Condensers • Pipe Coils • Freon Condensers • Dry-Ex Water Coolers • Oil Separators • Liquid Receivers • Flooded Water Coolers • Hi-Peak Water Coolers • Heat Exchangers

Write for Catalog on any item.

ACME PRODUCTS

ACME INDUSTRIES

JACKSON • MICHIGAN

Conseco ammonia heat exchanger installation, Stanley Theatre, Philadelphia.

CONSECO

Twenty years' specialized experience designing, fabricating and servicing heat exchangers assure sound design, quality construction and economical operation with any type refrigerant. Engineering assistance gladly furnished. Write.

HEAT EXCHANGERS for Air Conditioning

SERVICE

CONDENSER SERVICE & ENGINEERING CO., INC.

63 RIVER STREET, HOBOKEN, N. J. • *Phone Any Time*

TUBE CLEANING GUNS AND PLUGS
AIR AND EROSION ELIMINATORS
BEVEL GEAR UNIVERSAL JOINTS
STRAINERS, GREASE EXTRACTORS
WIZARD INJECTORS, FILTERS

CONDENSERS • LOW PRESSURE EVAPORATORS • AIR EJECTORS • HEAT EXCHANGERS • PUMPS

AMERICA'S largest selling PUMPS Provide Water For Industrial Service, Domestic Uses & Irrigation • Peerless offers the most complete line of vertical and horizontal pumps. Because of the extensiveness of the line, a pump of the size and exact type best suited for your pumping conditions, which makes for greatest economy of operation, is available to you. The Hi-Lift illustrated here is furnished in sizes of from 500 to 3,500 gallons per hour. The Hydro-Foil (Propeller Type) up to 220,000 gallons per minute.

DOMESTIC WATER SYSTEMS

The Water King, shallow well type, utilizing the HI-LIFT principle ingeniously applied in simplest form, in sizes up to 1,300 gallons per hour. **The Peerless Jet Pump,** for deep or shallow wells, is available in sizes up to 5,000 gallons per hour.

Peerless Distributors and Direct Factory Representatives Located In All Principal Cities

PEERLESS PUMPS

PEERLESS PUMP DIVISION
Food Machinery Corp.

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FACTORIES
LOS ANGELES 31, CALIFORNIA
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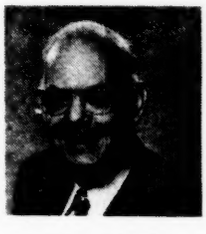
Kohler, treasurer, Kohler Co., representing the Sanitary Cast Iron Enameled Ware Association; R. E. Larson, sales manager, Wolverine Brass Works, representing the Tubular Plumbing Goods Institute; J. M. McClintock, manager, stoker division, Illinois Iron and Bolt Co., representing the Stoker Manufacturers Association; E. N. McDonnell, president, McDonnell & Miller, representing Steam Heating Equipment Manufacturers; H. O. Nelson, president, Nelson Co., representing The Central Supply Association; S. H. Perry, general sales manager, mill division, Chase Brass & Copper Co., representing the Copper & Brass Research Association; R. L. Stewart, vice-president, Stockham Pipe Fittings Co., representing The Pipe Fittings Manufacturers Association and The Valve Manufacturers Association; and Martin Weil, president, Weil-McLain Co., representing The Institute of Boiler and Radiator Manufacturers.

The return to the private heating industry of **Henry S. Norris,** until recently head of the Heating Branch of the War Production Board, has been announced by W. T. Winter, President of **Consolidated Industries, Inc.,** Lafayette, Indiana. Mr. Norris has been appointed vice-president of Consolidated and will be in charge of sales administration. He is a native of Frederick County, Maryland, a graduate of Princeton University, and has had a long experience in the heating field. Until 1929 he was associated with the American Radiator Co. in New York, the Installation Engineering Co., and the M. E. Conran Co., Inc. In 1929 he formed his own firm, the Nassau Engineering Co., and represented the Iron Fireman Co. and the Carrier Corp. During his tenure as president of his company, Mr. Norris' firm became the leading stoker and air-conditioning company on Long Island. Called to the War Production Board in 1942, Mr. Norris was first in charge of cast iron boilers and radiators and steel heating boilers, and was later put in charge of the oil conservation program for WPB. For the past 18 months, he has been in charge of the Heating branch of WPB, responsible for all heating equipment manufactured in this country. Some 1,600 companies, doing business in excess of a half-billion dollars annually, were his domain. The Heating Branch of WPB consisted of 26 persons, eight of whom were specialists in various phases of the heating industry. In directing their activities, Mr. Norris has doubtless achieved the widest acquaintance in the heating industry of any single individual in the United States, according to the Consolidated announcement.



H. S. Norris

George O. Boomer, longtime associate of the late Walter H. Girdler, Sr., founder of **Tube Turns, Inc.,** Louisville, Ky., was elected president of the firm at a recent meeting of the board of directors. He was vice-president of the company at the time Mr. Girdler died last January.

Maxwell F. Rather, eastern district manager for the **Johnson Service Co.,** Milwaukee, Wis., has been elected vice-president. He joined the company in 1915 as a sales engineer, two years after his graduation from the College of Engineering, University of Wisconsin. He was branch manager of the Cleveland office for 20 years before he was transferred to New York. He will continue his work in New York as manager of the eastern district and of the export division.

O. G. Ward, vice-president, is district manager at Chicago, and **J. A. Cutler,** president, directs the activities of the western district.

George O. Boomer, president of **Tube Turns,** announces that the board of directors has approved the leasing from the Reconstruction Finance Corporation of $3,000,000 worth of Defense Plant Corporation equipment, which had been installed for war work. At the same time, he said, the board also authorized the purchase of additional equipment costing $500,000, to round out the company's production facilities. When the plant expansion program is completed, Tube Turns will be $3,500,000 bigger than in prewar years and will have one of the largest and most complete manufacturing establishments of its kind in the United States.

Lowell M. Birrell has been elected chairman of the board of directors of the **Anemostat Corp. of America,** 10 East 39th Street, New York, N. Y., it was announced by August Rust-Oppenheim, President of the company. Simultaneously, at the board meeting, **Irving M. Felt** was named a director of the firm. Mr. Birrell is also President of Claude Neon Lights Company, Inc., and Greater New York Industries, Inc., New York, N. Y. Mr. Felt is also President of the Union Aircraft Products Corporation and the Jefferson-Travis Corporation, New York, N. Y. Besides the plant in New York City, Anemostat maintains a factory at 1031 New Britain Avenue, Hartford, Conn., where air-conditioning equipment is manufactured.

Martyn Kingsland, manager of the **Minneapolis-Honeywell Regulator Co.,** refrigeration controls division, has been named sales manager of the newly formed specialties division, and will consolidate the activities of his former department with the new division. The new division also will handle modification of the company's regular heating and air conditioning controls for special applications.

M. Kingsland

J. A. Cain

James A. Cain, formerly assistant manager of **A. M. Byers Co.,** Pittsburgh Division, has been appointed manager of a divisional office at 817 William Oliver Building, Atlanta. He has been associated with the Byers organization since 1942, and since May 1, 1944, has been assistant division manager of the Pittsburgh Division which included the southern territory that is now in the Atlanta division. The new division will include Georgia, North and South Carolina, Florida, Alabama and parts of Tennessee.

The Marsh Tritrol Co. has broadened its activities and will now distribute the heating specialties distributed by **Jas. P. Marsh Corp.** along with the Marsh Tritrol regulator. To better describe the broadened operations, the firm name is being changed to **Marsh Heating Equipment Co.** Main offices are located at 2122 Southport Ave., Chicago. **James Emmett, Jr.,** will head the staff as vice-president in charge of sales. The purpose of the Marsh Heating Equipment Co. is to combine the distribution of Marsh Heating Specialties and the Marsh Tritrol regulator—closely related products—so that a better engineering and consulting service can be rendered those who install or use these products.

There's a certain thrill in trying to beat the shell game. And if you lose, at least you have been entertained.

But it's not entertainment, it's business when you shop around for low-priced plumbing supplies. And it's no fun to find that you have bought a pile of headaches.

Why take those risks when a reputable plumbing and heating jobber is just around the corner? Patronize him and let him supply you with trademarked, quality merchandise.

KUHNS BROTHERS CO.

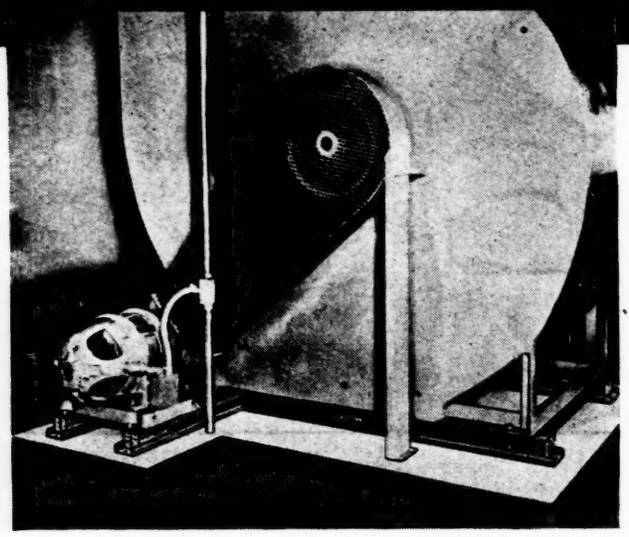
DAYTON 7, OHIO

K

CAST FITTINGS

"K" fittings are carried in stock at Malleable Iron Fittings Co., Branford, Conn.; M.I.F. stocks at Kuhns Bros. Co., Dayton, Ohio.

ISOLATE VIBRATION AND NOISE *from* FANS AND BLOWERS



Typical installation of fan and motor on Korfund isolating fan base.

KORFUND TWIN RAIL FAN BASE is a development in fan and blower isolation to assure efficient isolation of noise and vibration at an unusually low cost.

Interchangeable prefabricated parts are used throughout. It is light in weight, yet has great rigidity to vertical and lateral stresses. The Twin Rail Base is easily assembled and installed. Caps designed to hold fan and motor housings are securely clamped, yet can be repositioned by unlocking a single nut. Isolators provide uniform loading and can also be repositioned to compensate for unequal weight distribution.

Write for Bulletin TR-800 for further information on Korfund Twin Rail Fan Base.

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THE KORFUND COMPANY, Inc., 48-33 32nd ST., LONG ISLAND CITY 1, NEW YORK

K. G. Baker is back with the Indianapolis office of **Wagner Electric Corp.**, as a field engineer after over three years' active duty with the Army. Mr. Baker is a veteran of both World Wars, having served overseas both times. In World War I he served with the 32nd Division, spending seventeen months in France and with the army of occupation in Germany. Upon his return home in 1919 he entered Purdue University where he was graduated in 1923. He returned to the Army on April 5, 1942, with the rank of Captain and went to Drew Field and advanced to the rank of Lieutenant Colonel.

K. G. Baker

Mr. Baker's record with Wagner dates back to March 1, 1929, when he joined the company as sales-engineer, working out of their Cincinnati office. At that time he made his home in Louisville, Ky. In the fall of 1931, he was transferred to the Indianapolis office which was his headquarters until he returned to the Army in 1942.

Leonard C. Bastian, who, for several years prior to the war, was staff standardization engineer of the **Air Conditioning and Refrigerating Machinery Association,** Washington, D. C., has rejoined ACRMA following his release from active duty as a Lieutenant-Commander in the Civil Engineer Corps of the Navy.

Waterman Steamship Corp., Mobile, Alabama, has announced the establishment of a research project in the Engineering Research Division, **Southern Research Institute.** The program will include all phases of design and improvements of marine equipment and will be under the direction of **E. N. Kemler,** head of the division, and **G. B. Clark** of the Waterman Research Laboratory.

NEW CATALOGS

Hospital Heating

Bulletin No. 633 entitled "A Step Ahead in Hospital Heating" describes the principle of Dunham differential heating by varying steam pressures under vacuum and points out that while the principle has been applied for many years to all types of buildings it should be considered in the cost estimates of new construction. The bulletin gives several installation histories and cost analyses.—*C. A. Dunham Co., 450 East Ohio St., Chicago 11, Ill.*

Foamglas, Insulation Agent

One of the glass industry's wartime research products, Foamglas, a cellular glass insulating material is finding wide usage as a heat resisting insulation on towers, tanks and ducts throughout the petroleum industry. A summation of the physical qualities of the product relative to its use in the petroleum and allied industries is incorporated in a 24-page illustrated booklet.—*Pittsburgh Corning Corp., 632 Duquesne Way, Pittsburgh 22, Pa.*

Instruments

Four-page bulletin (No. 2982) describing Alnor instruments including pyrometers, electrical resistance thermometers, temperature controls, velometers, etc.—*Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago 10, Ill.*

Steel Riveted Boilers

Catalog No. 96 "E" illustrates in color and describes with fully detailed tabulations and diagrams Kewanee high pressure firebox boilers in cut-away cuts.

Other High Pressure Boiler specifications are also condensed in tables with illustrations on All Weld Hi-Test and on Scottie Jr., including the new 6 hp sizes.—*Kewanee Boiler Corporation, Kewanee, Ill.*

Radiant Heating

A 10-page booklet presenting the history, theory, benefits, and installation of Hydro-Flow radiant panel heating.—*Bell & Gossett Co., Morton Grove, Ill.*

COMING EVENTS

DECEMBER 10-12—Annual meeting of the American Society of Refrigeration Engineers, Hotel Pennsylvania, New York City. David L. Fiske, Secretary, 40 W. 40th St., New York 18, N. Y.

JANUARY 28-30, 1946—52nd Annual Meeting of the American Society of Heating and Ventilating Engineers, Hotel Commodore, New York City. C. V. Hutchinson, Secretary, 51 Madison Ave., New York.

FEBRUARY 25-28, 1946—National Association of Home Builders' Exposition, Stevens Hotel, Chicago. Paul S. Van Auken, Convention and Exposition Director for the Association, 111 W. Jackson, Chicago.

FEB. 25-MAR. 2, 1946—20th Exposition of Chemical Industries, Grand Central Palace, New York City. C. F. Roth, manager of the Exposition, Grand Central Palace, New York 17, N. Y.

MARCH 4-7, 1946—Open meeting of Refrigeration Equipment Manufacturers Association with refrigeration jobbers and service engineers, Stevens Hotel, Chicago. Theodore R. Sills, Refrigeration Equipment Manufacturers Association, 43 East Ohio Street, Chicago 11, Ill.

APRIL 23-27, 1946—National Oil Heat Exposition in conjunction with the annual convention of Oil-Heat Institute of America, Commercial Museum, Philadelphia, Pa. C. F. Curtin, secretary of the Institute at 30 Rockefeller Plaza, New York 20.

MAY 7-9, 1946—Annual meeting and exhibition of the National Association of Corrosion Engineers, President Hotel and Municipal Auditorium, Kansas City, Mo. Elton Sterrett, executive secretary, 318 Southern Standard Building, 711 Main Street, Houston 2, Texas.

MAY 20-25, 1946—National Marine Exposition, Grand Central Palace, New York City, under the sponsorship of the Propeller Club of the United States. Roger E. Montgomery, general manager, National Marine Expositions, Inc., 17 Battery Place, New York, N. Y.

SEPTEMBER 16-20, 1946—1946 Exhibit and Conference of the Instrument Society of America, to be held in Pittsburgh, Pa. For further details write to Paul G. Exline of the Society at 1117 Wolfendale Street, Pittsburgh 12, Pa.

OCT. 28-NOV. 1, 1946—REMA annual all-industry refrigeration and air conditioning show, Cleveland Public Auditorium, Cleveland, Ohio. Refrigeration Equipment Manufacturers Association, 43 East Ohio Street, Chicago 11, Ill.

The complete illustrated story of INSULATING DUCTS with Dux-Sulation is yours for the asking. 8 Pages of valuable, interesting information, and money saving facts will prove to be of great value to you. Crammed full of tables and pictures of actual installations.

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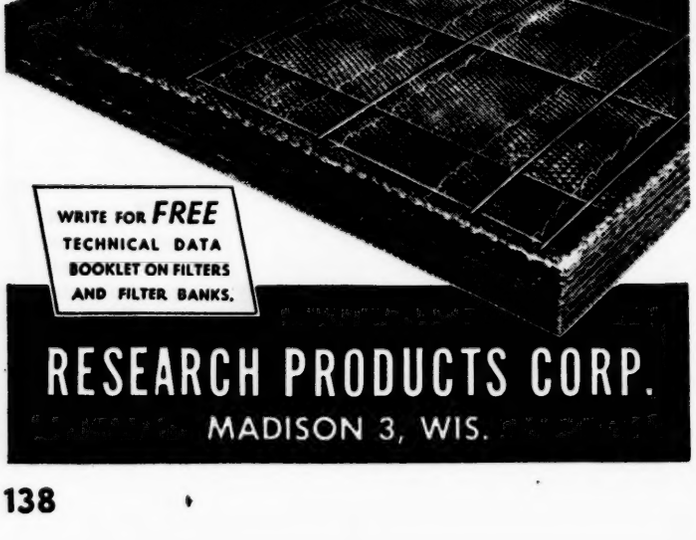

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How much
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STEAM LOSSES FROM PIPING – 7 TO 24 INCH PIPE

A	B	C	D	E	F	Pipe Size, Nominal Diameter, Inches									
Temp. Diff., F	Sat. Steam Temp., F (Col. A + 70F)	Abs. Steam Press. Corresponding to B	Latent Heat of Vapor, Btu per Lb	Heat Loss, Btu per Sq Ft per Hr	Heat Loss, Lb per Sq Ft per Hr (E÷D)	7	8	9	10	12	14	16	18	20	24
						Outside Surface Area of Pipe per 100 Ft of Pipe, Sq Ft									
						199.62	225.80	251.98	281.43	333.80	366.52	418.88	471.24	523.60	628.32
						Heat Loss from Bare Piping in Pounds of Steam per 100 Ft of Pipe									
50	120	1.692	1025.1	97.50	0.0951	18.98	21.47	23.96	26.76	31.74	34.86	39.84	44.81	49.79	59.75
55	125	1.941	1022.2	109.27	0.1069	21.34	24.14	26.94	30.08	35.68	39.18	44.78	50.38	55.97	67.17
60	130	2.221	1019.4	121.04	0.1187	23.69	26.80	29.91	33.41	39.62	43.51	49.72	55.94	62.15	74.58
65	135	2.536	1016.5	132.81	0.1307	26.09	29.51	32.93	36.78	43.63	47.90	54.75	61.59	68.43	82.12
70	140	2.887	1013.6	144.58	0.1426	28.47	32.20	35.93	40.13	47.60	52.27	59.73	67.20	74.67	89.60
75	145	3.280	1010.6	156.35	0.1547	30.88	34.93	38.98	43.54	51.64	56.70	64.80	72.90	81.00	97.20
80	150	3.716	1007.7	168.12	0.1668	33.30	37.66	42.03	46.94	55.68	61.14	69.87	78.60	87.34	104.80
85	155	4.201	1004.7	179.89	0.1790	35.73	40.42	45.10	50.38	59.75	65.61	74.98	84.35	93.72	112.47
90	160	4.739	1001.8	191.66	0.1913	38.19	43.20	48.20	53.84	63.86	70.12	80.13	90.15	100.16	120.20
95	165	5.334	998.8	203.43	0.2037	40.66	46.00	51.33	57.33	68.00	74.66	85.33	95.99	106.66	127.99
100	170	5.990	995.8	215.20	0.2161	43.14	48.80	54.45	60.82	72.13	79.20	90.52	101.83	113.15	135.78
105	175	6.716	992.8	229.68	0.2313	46.17	52.23	58.28	65.09	77.21	84.78	96.89	109.00	121.11	145.33
110	180	7.510	989.8	244.16	0.2467	49.25	55.70	62.16	69.43	82.35	90.42	103.34	116.25	129.17	155.01
115	185	8.382	986.8	258.64	0.2621	52.32	59.18	66.04	73.76	87.49	96.06	109.79	123.51	137.24	164.68
120	190	9.336	983.8	273.12	0.2776	55.41	62.68	69.95	78.12	92.66	101.75	116.28	130.82	145.35	174.42
125	195	10.385	980.8	287.60	0.2932	58.53	66.20	73.88	82.52	97.87	107.46	122.82	138.17	153.52	184.22
130	200	11.525	977.7	302.08	0.3090	61.68	69.77	77.86	86.96	103.14	113.25	129.43	145.61	161.79	194.15
135	205	12.772	974.6	316.56	0.3248	64.84	73.34	81.84	91.41	108.42	119.05	136.05	153.06	170.07	204.08
140	210	14.123	971.5	331.04	0.3408	68.03	76.95	85.87	95.91	113.76	124.91	142.75	160.60	178.44	214.13
145	215	16	968.3	345.52	0.3568	71.22	80.57	89.91	100.41	119.10	130.77	149.46	168.14	186.82	224.18
150	220	17	965.1	360.00	0.3730	74.46	84.22	93.99	104.97	124.51	136.71	156.24	175.77	195.30	234.36
155	225	19	961.7	377.30	0.3923	78.31	88.58	98.85	110.40	130.95	143.79	164.33	184.87	205.41	246.49
160	230	21	958.6	394.60	0.4116	82.16	92.94	103.71	115.84	137.39	150.86	172.41	193.96	215.51	258.62
165	235	23	955.0	411.90	0.4313	86.10	97.39	108.68	121.38	143.97	158.08	180.66	203.25	225.83	270.99
170	240	25	952.0	429.20	0.4508	89.99	101.79	113.59	126.87	150.48	165.23	188.83	212.43	236.04	283.25
175	245	27	949.0	446.50	0.4705	93.92	106.24	118.56	132.41	157.05	172.45	197.08	221.72	246.35	295.62
180	250	30	945.2	463.80	0.4907	97.95	110.80	123.65	138.10	163.80	179.85	205.54	231.24	256.93	308.32
185	255	33	941.2	481.10	0.5112	102.05	115.43	128.81	143.87	170.64	187.37	214.13	240.90	267.66	321.20
190	260	35	938.4	498.40	0.5311	106.02	119.92	133.83	149.47	177.28	194.66	222.47	250.28	278.08	333.70
195	265	39	934.4	515.70	0.5519	110.17	124.62	139.07	155.32	184.22	202.28	231.18	260.08	288.97	346.77
200	270	42	931.4	533.00	0.5723	114.24	129.23	144.21	161.06	191.03	209.76	239.73	269.69	299.66	359.59
205	275	45	928.2	553.48	0.5963	119.03	134.64	150.26	167.82	199.04	218.56	249.78	281.00	312.22	374.67
210	280	49	924.2	573.96	0.6210	123.96	140.22	156.48	174.77	207.29	227.61	260.12	292.64	325.16	390.19
215	285	53	920.9	594.44	0.6455	128.85	145.75	162.65	181.66	215.47	236.59	270.39	304.19	337.98	405.58
220	290	58	917.0	614.92	0.6706	133.87	151.42	168.98	188.73	223.85	245.79	280.90	316.01	351.13	421.35
225	295	62	913.4	635.40	0.6956	138.86	157.07	175.28	195.76	232.19	254.95	291.37	327.79	364.22	437.06
230	300	67	909.6	655.88	0.7211	143.95	162.82	181.70	202.94	240.70	264.30	302.05	339.81	377.57	453.08
235	305	72	906.0	676.36	0.7465	149.02	168.56	188.10	210.09	249.18	273.61	312.69	351.78	390.87	469.04
240	310	78	902.1	696.84	0.7725	154.21	174.43	194.65	217.40	257.86	283.14	323.58	364.03	404.48	485.38
245	315	84	898.3	717.32	0.7985	159.40	180.30	201.21	224.72	266.54	292.67	334.48	376.29	418.09	501.71
250	320	90	894.4	737.80	0.8249	164.67	186.26	207.86	232.15	275.35	302.34	345.53	388.73	431.92	518.30
255	325	96	890.6	761.82	0.8554	170.75	193.15	215.54	240.74	285.53	313.52	358.31	403.10	447.89	537.46
260	330	103	886.5	785.84	0.8865	176.96	200.17	223.38	249.49	295.91	324.92	371.34	417.75	464.17	557.01
265	335	110	882.7	809.86	0.9175	183.15	207.17	231.19	258.21	306.26	336.28	384.32	432.36	480.40	576.48
270	340	118	878.5	833.88	0.9492	189.48	214.33	239.18	267.13	316.84	347.90	397.60	447.30	497.00	596.40
275	345	126	874.4	857.90	0.9811	195.85	221.53	247.22	276.11	327.49	359.59	410.96	462.33	513.70	616.44
280	350	135	870.2	881.92	1.0135	202.31	228.85	255.38	285.23	338.31	371.47	424.53	477.60	530.67	636.80
285	355	144	865.8	905.94	1.0464	208.88	236.28	263.67	294.49	349.29	383.53	438.32	493.11	547.90	657.47
290	360	153	861.7	929.96	1.0792	215.43	243.68	271.94	303.72	360.24	395.55	452.06	508.56	565.07	678.08
295	365	163	857.4	953.98	1.1126	222.10	251.23	280.35	313.12	371.39	407.79	466.05	524.30	582.56	699.07
300	370	173	853.0	978.00	1.1465	228.86	258.88	288.90	322.66	382.70	420.22	480.25	540.28	600.31	720.37
305	375	184	848.6	1007.14	1.1868	236.91	267.98	299.05	334.00	396.15	434.99	497.13	559.27	621.41	745.69
310	380	196	844.1	1036.28	1.2277	245.07	277.21	309.36	345.51	409.81	449.98	514.26	578.54	642.82	771.39
315	385	208	839.5	1065.42	1.2691	253.34	286.56	319.79	357.16	423.63	465.15	531.60	598.05	664.50	797.40
320	390	220	834.9	1094.56	1.3110	261.70	296.02	330.35	368.95	437.61	480.51	549.15	617.80	686.44	823.73
325	395	233	830.3	1123.70	1.3534	270.17	305.60	341.03	380.89	451.76	496.05	566.91	637.78	708.64	850.37
330	400	248	825.5	1152.84	1.3965	278.77	315.33	351.89	393.02	466.15	511.85	584.97	658.09	731.21	877.45
335	405	262	820.6	1181.98	1.4404	287.53	325.24	362.95	405.37	480.81	527.94	603.35	678.77	754.19	905.03
340	410	277	815.8	1211.12	1.4846	296.36	335.22	374.09	417.81	495.56	544.14	621.87	699.60	777.34	932.80
345	415	292	810.8	1240.26	1.5297	305.36	345.41	385.45	430.50	510.61	560.67	640.76	720.86	800.95	961.14
350	420	309	805.8	1269.40	1.5753	314.46	355.70	396.94	443.34	525.84	577.38	659.86	742.34	824.83	989.79
355	425	326	800.7	1303.86	1.6284	325.06	367.69	410.32	458.28	543.56	596.84	682.10	767.37	852.63	1023.2
360	430	344	795.5	1338.32	1.6824	335.84	379.89	423.93	473.48	561.59	616.63	704.72	792.81	880.90	1057.1
365	435	362	790.2	1372.78	1.7373	346.80	392.28	437.76	488.93	579.91	636.76	727.72	818.69	909.65	1091.6
370	440	382	784.9	1407.24	1.7929	357.90	404.84	451.77	504.58	598.47	657.13	751.01	844.89	938.76	1126.5

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STEAM LOSSES FROM PIPING – 7 TO 24 INCH PIPE

A	B	C	D	E	F	Pipe Size, Nominal Diameter, Inches									
Temp. Diff., F	Sat. Steam Temp., F (Col. A + 70F)	Abs. Steam Press. Corresponding to B	Latent Heat of Vapor., Btu per Lb	Heat Loss, Btu per Sq Ft per Hr	Heat Loss, Lb per Sq Ft per Hr (E÷D)	7	8	9	10	12	14	16	18	20	24
						Outside Surface Area of Pipe per 100 Ft of Pipe, Sq Ft									
						199.62	225.80	251.98	281.43	333.80	366.52	418.88	471.24	523.60	628.32
						Heat Loss from Bare Piping in Pounds of Steam per 100 Ft of Pipe									
375	445	402	779.4	1441.70	1.8498	369.26	417.68	466.11	520.59	617.46	677.99	774.84	871.70	968.56	1162.3
380	450	423	773.8	1476.16	1.9077	380.82	430.76	480.70	536.88	636.79	699.21	799.10	898.98	998.87	1198.6
385	455	444	768.1	1510.62	1.9667	392.59	444.08	495.57	553.49	656.48	720.83	823.81	926.79	1029.8	1235.7
390	460	467	762.3	1545.08	2.0269	404.61	457.67	510.74	570.43	676.58	742.90	849.03	955.16	1061.3	1273.5
395	465	490	756.4	1579.54	2.0882	416.85	471.52	526.18	587.68	697.04	765.37	874.71	984.04	1093.4	1312.1
400	470	515	750.3	1614.00	2.1511	429.40	485.72	542.03	605.38	718.04	788.42	901.05	1013.7	1126.3	1351.6
405	475	540	744.1	1657.66	2.2277	444.69	503.01	561.34	626.94	743.61	816.50	933.14	1049.8	1166.4	1399.7
410	480	566	737.8	1701.32	2.3059	460.30	520.67	581.04	648.95	769.71	845.16	965.90	1086.6	1207.4	1448.8
415	485	593	731.3	1744.98	2.3861	476.31	538.78	601.25	671.52	796.48	874.55	999.49	1124.4	1249.4	1499.2
420	490	622	724.7	1788.64	2.4681	492.68	557.30	621.91	694.60	823.85	904.61	1033.8	1163.1	1292.3	1550.8
425	495	651	718.0	1832.30	2.5519	509.41	576.22	643.03	718.18	851.82	935.32	1068.9	1202.6	1336.2	1603.4
430	500	681	711.1	1875.96	2.6381	526.62	595.68	664.75	742.44	880.60	966.92	1105.0	1243.2	1381.3	1657.6
435	505	712	704.1	1919.62	2.7263	544.22	615.60	686.97	767.26	910.04	999.24	1142.0	1284.7	1427.5	1713.0
440	510	745	696.9	1963.28	2.8172	562.37	636.12	709.88	792.84	940.38	1032.6	1180.1	1327.6	1475.1	1770.1
445	515	778	689.6	2006.94	2.9103	580.95	657.15	733.34	819.05	971.46	1066.7	1219.1	1371.4	1523.8	1828.6
450	520	813	682.1	2050.60	3.0063	600.12	678.82	757.53	846.06	1003.5	1101.9	1259.3	1416.7	1574.1	1888.9
455	525	848	674.6	2104.54	3.1197	622.75	704.43	786.10	877.98	1041.4	1143.4	1306.8	1470.1	1633.5	1960.2
460	530	885	666.8	2158.48	3.2371	646.19	730.94	815.68	911.02	1080.5	1186.5	1356.0	1525.5	1694.9	2033.9
465	535	923	659.0	2212.42	3.3572	670.16	758.06	845.95	944.82	1120.6	1230.5	1406.3	1582.0	1757.8	2109.4
470	540	963	651.0	2266.36	3.4814	694.96	786.10	877.24	979.77	1162.1	1276.0	1458.3	1640.6	1822.9	2187.4
475	545	1003	642.8	2320.30	3.6097	720.57	815.07	909.57	1015.9	1204.9	1323.0	1512.0	1701.0	1890.0	2268.0
480	550	1045	634.5	2374.24	3.7419	746.96	844.92	942.88	1053.1	1249.0	1371.5	1567.4	1763.3	1959.3	2351.1
485	555	1089	626.1	2428.18	3.8783	774.19	875.72	977.25	1091.5	1294.6	1421.5	1624.5	1827.6	2030.7	2436.8
490	560	1133	617.5	2482.12	4.0196	802.39	907.63	1012.9	1131.2	1341.7	1473.3	1683.7	1894.2	2104.7	2525.6
495	565	1180	608.7	2536.06	4.1664	831.70	940.77	1049.8	1172.5	1390.7	1527.1	1745.2	1963.4	2181.5	2617.8
500	570	1228	599.7	2590.00	4.3188	862.12	975.19	1088.3	1215.4	1441.6	1582.9	1809.1	2035.2	2261.3	2713.6

The accompanying table (a companion to Reference Data 283-284 covering ½ to 6 in. pipe) gives the heat loss from steam pipe (or flat surfaces) in terms of pounds of steam, for bare and insulated pipe, provided the following are known: (1) pipe size and length; (2) steam pressure; (3) steam quality (whether saturated or superheated—if the latter, degree of superheat); (4) air temperature surrounding pipe; and (5) insulation efficiency factor, if loss when covered is desired. Use of the tables, which were computed by Charles A. Pohlig, is explained on Reference Data 283-284.

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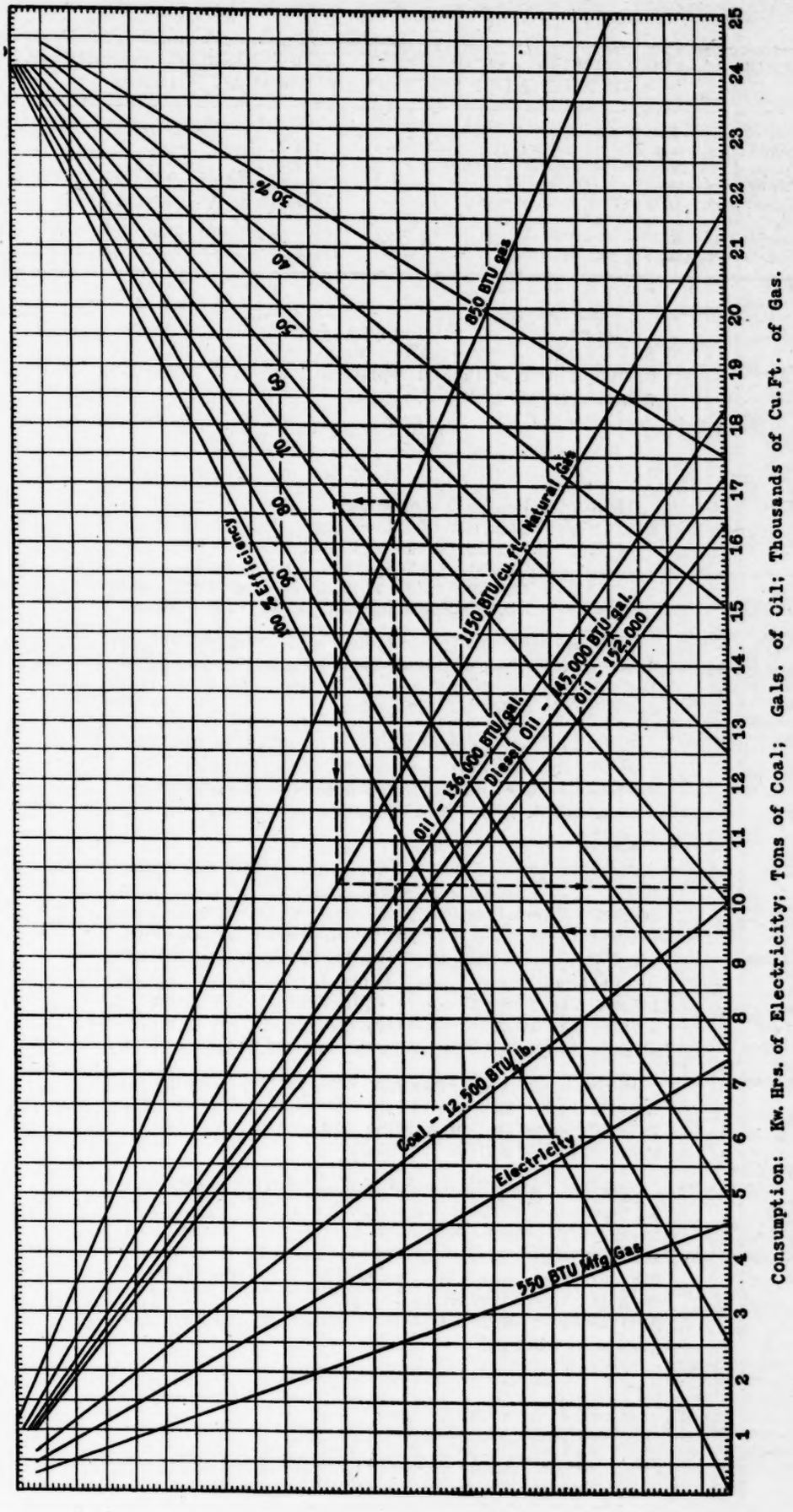
GRAPHICAL SOLUTION, FUEL EQUIVALENT FORMULA



Consumption: Kw. Hrs. of Electricity; Tons of Coal; Gals. of Oil; Thousands of Cu.Ft. of Gas.

Chart designed by C. C. McRae

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GRAPHICAL SOLUTION, FUEL EQUIVALENT FORMULA

TABLE 1.—APPROXIMATE EQUIVALENTS, BASED ON 100% EFFICIENCY, FOR DETERMINING POSITION OF DECIMAL POINT

Tons of 12,500 Btu per lb coal	1							
Gallons of 152,000 Btu per gal oil	164	1						
Gallons of 145,000 Btu per gal oil	172	1.05	1					
Gallons of 136,000 Btu per gal oil	184	1.12	1.07	1				
Kilowatt-hours of electricity	7327	44.5	42	40	1			
Cubic feet of 1150 Btu per cu ft gas	21700	132	126	118	2.97	1		
Cubic feet of 850 Btu per cu ft gas	29412	179	170	160	4.02	1.35	1	
Cubic feet of 550 Btu per cu ft gas	45454	276	264	247	6.20	2.09	1.55	1

The chart on the reverse side of the sheet is a graphical solution of the equation for determining the equivalent quantity of fuel to replace another fuel. That is, it is a solution of the equation

$$X = \frac{M \times H_m \times E_m}{H_x \times E_x}$$

where X = Required equivalent;
M = Quantity of known fuel;
H_m = Heating value of known fuel;
E_m = Operating efficiency of known fuel;
H_x = Heating value of required equivalent; and
E_x = Operating efficiency of required equivalent.

The resulting answers, as on a slide rule, do not indicate the position of the decimal points. To determine the position of the decimal point use Table 1 as indicated in the following examples:

Example: For a given process 9.5 gallons of diesel oil (145,000 Btu per gal) are burned at an estimated 60% efficiency. How much 1150 Btu per cu ft natural gas will be required for this process if burned at 70% efficiency?

Solution: Locate 9.5 on horizontal scale, move vertically to the diesel oil curve, horizontally to the 60% efficiency curve, vertically to the 70% curve and horizontally to the 1150 Btu natural gas curve, thence downward and locate 10.25 M cu ft or 10250 cu ft uncorrected for decimal place. From Table 1 note that 1 gal of 145,000 Btu per gal oil is equivalent to 126 cu ft of natural gas at 100% efficiency so that 10 gal is equivalent to 1260 cu ft; therefore the answer is 1025.0 cu ft.

Example: A 60% efficiency coal system burning 52 tons of 12,500 Btu per lb coal is to be replaced by a 70% efficiency system burning 136,000 Btu per gal oil. How much oil will be required?

Solution: Ignoring decimal points, move upward from 5.2 on the horizontal scale to the coal curve, horizontally to the 60% curve, vertically to the 70% curve, horizontally to the 136,000 oil curve thence down and read 815 gal, uncorrected for decimal point. From Table 1, each ton is equivalent to 184 gal so 50 tons would be equivalent to 9000 gal at 100 efficiency, so that the answer is 8150 gal.

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CORROSION RESISTANT METAL SELECTION FOR INDUSTRIAL PIPING

Adapted from a table designed by L. G. Vande Bogart, Research Engineer, for Crane Company

The purpose of the tabulation beginning on the reverse side of this sheet, and concluded on Reference Data 293-294, is to provide, in condensed form, a key to the selection of the proper metal for valves, fittings and piping of a relatively large number of industrial fluids. Adapted from a similar one designed by L. G. Vande Bogart, research engineer, Crane Company, the table is reproduced here through the courtesy and permission of Mr. Vande Bogart and Crane Co.

Although originally designed for valves, fittings and pipe the table applies equally to other types of equipment for all normal purposes. The table, as originally compiled, was published to enable prospective users to compare the corrosion resistance of several materials in the same environment to determine which could *best* be used. However, it is not always possible to obtain the best material for a specific application. Frequently it becomes necessary to select a material on the basis of *availability* rather than *desirability;* the tables, therefore, are offered to enable users to compare some material which is available with some other material which is known to be better but which is not available.

The footnotes or references below apply to corresponding numbers in the table; this arrangement of notes, preceding the reference is unconventional but, in this case, desirable as a means of space-saving.

Materials listed in the tables include "nickel cast iron" which is more completely defined as a corrosion-resistant non-magnetic cast iron containing nickel, chromium and copper. The "stainless steel" listed is one containing 18% chromium, 8% nickel and from 2 to 3% of molybdenum.

REFERENCE NOTES

(1) Severe corrosion sometimes experienced at locations where liquid changes to vapor and vice-versa.

(2) Iron and steel used. but combinations that produce sparks should be avoided at valve seats. High copper alloys prohibited by codes. Yellow brass acceptable.

(3) These recommendations apply to the industrial use of ammonia gas and to low temperature stages of its manufacture. They do not all apply to the handling of hot gases in its manufacture by the synthetic process.

(4) Iron and steel used. Some trouble experienced with hot solutions, especially adjacent to welds. Wherever possible welds should be stress relieved. Stainless steel first choice.

(5) Iron and steel used for handling beer in the Alcohol Industry but not permissible in the Beverage Industry.

(6) Recommendations do not apply to handling of these compounds at high temperatures. Behaviour when hot depends largely on amount and nature of impurities. See Note under "Hydrogen Sulfide and Organic Sulfur Compounds." Also see Note 16.

(7) Commonly encountered as pulping liquor in the pulp and paper industry. Copper and brass have been used in past and can be used again in emergency. Stainless steel (Type 316 or 317) preferred. Bronze valves should be trimmed with stainless steel.

(8) Iron and steel used for refrigerating brines. Severe corrosion indicates need for control of solution.

(9) These recommendations are based on industrial uses of the solvent. Galvanized steel commonly used for tanks, piping, etc. Iron and steel are widely used in manufacture of solvent, with good success.

(10) Industrial applications of "dry" chlorine frequently involve locations where moisture is present. Steel gives good results as piping material but something better is needed for critical parts. Steel valves trimmed with monel or Hastelloy C give good results. Non-metals required for wet gas and aqueous solutions.

(11) Steel, with or without lead lining, used for tanks, piping, etc. Corrosion of unlined steel adjacent to welds is common. Wherever possible welds should be stress-relieved if steel is not to be lined. Impingement by rapidly moving solution—especially when hot — may cause severe corrosion.

(12) See "Water, Acid Mine." Presence of copper sulfate and/or ferric sulfate in dilute sulfuric acid inhibits the attack of this acid on stainless steel.

(13) Non-metals usually indicated. Hastelloy C used with some success.

(14) Non-metals usually indicated. Hastelloys used with excellent results. Hastelloy B used as trim in steel valves in hydrochloric alkylation. Red brass or bronze valves with nickel alloy trim work well with dilute solutions (<1%). Do not use Hastelloys with acid that has previously been in contact with copper alloys and has become contaminated with copper salts.

(15) Steel standard for piping in hydrofluoric acid manufacture and in hydrofluoric alkylation. Steel valves should be trimmed with monel metal or Hastelloy B.

(16) Recommendations apply to gas when used at ordinary temperatures. Extreme care should be exercised when the gas is to be handled at elevated temperatures, as in hydrogenation and dehydrogenation processes, etc.

(17) Recommendations apply to dry gas at ordinary temperatures. Nickel alloys very susceptible at elevated temperatures.

(18) Commonly encountered as constituents of nickel plating solutions, when equipment should be lead, lead-lined, Duriron or rubber-lined.

(19) Straight chromium alloys used in preference to chromium-nickel alloys when feasible.

(20) Special high chromium-nickel alloys required.

(21) Includes Black, Green, and White Liquors encountered in Kraft paper mills. Iron and steel used for general piping. Low nickel (1–2%) cast iron much superior to nickel-free cast iron and widely used for valve bodies, fittings, etc. Stainless steel used for valve trim. Evaporator tubes may require special alloys.

(22) When gas is wet apply recommendations for "Sulfurous Acid."

(23) When gas is wet apply recommendations for "Sulfuric Acid (<10%)."

(24) Sulfur trioxide, either as a constituent of fuming sulfuric acid or when being handled as a gas, is capable of penetrating cast iron along the grain boundaries and causing intergranular cracking. Much cast iron equipment is used, but safety considerations suggest that steel should be used wherever possible.

(25) Special high chromium-nickel alloys having good resistance to a wide range of concentrations are being used. Ordinary iron and steel good where concentration remains over 90%. Absorption of moisture from the air dilutes exposed acid and makes it more corrosive to iron.

(26) Current practice in many cases where a mineral-free water is required is to use the effluent from a softener employing "hydrogen" zeolites. Such water may be distinctly "acid" and correspondingly corrosive. Final application may require that it be handled in rubber-lined pipe or in piping made of stainless steel, monel metal, etc.

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CORROSION RESISTANT METAL SELECTION FOR INDUSTRIAL PIPING

Adapted from a table designed by L. G. Vande Bogart, Research Engineer, for Crane Company

KEY: (OK)—Can be used (NO)—Should not be used (?)—Proceed with caution (—)—Information lacking

Fluid Handled	Iron and Steel	Nickel Cast Iron	Stainless Steel (18-8 Mo)	Monel Metal	Nickel	Red Brass	Acid Resisting Bronze	Aluminum
Acetate solvents, crude	?	?	?	OK	OK	?	OK	OK
Acetate solvents, pure	?	OK	OK	OK	OK	OK	OK	OK
Acetic acid, crude	?	?	OK	?	?	?	OK	?
Acetic acid, pure	NO	NO	OK	OK	?	NO	OK	OK
Acetic acid vapors (1)	NO	NO	OK	?	—	?	NO	?
Acetic anhydride	?	OK	OK	OK	—	NO	?	OK
Acetone	OK	OK	OK	OK	OK	OK	OK	OK
Acetylene (2)	OK	OK	OK	OK	OK	NO	NO	OK
Alcohols	OK	OK	OK	OK	OK	OK	OK	OK
Aluminum sulfate; alums	NO	?	OK	OK	—	?	?	?
Ammonia gas (3)	OK	OK	OK	OK	OK	NO	NO	OK
Ammonium chloride	?	OK	?	OK	OK	?	?	NO
Ammonium hydroxide; ammonia liquors	OK	OK	OK	?	?	NO	NO	OK
Ammonium nitrate (4)	OK	?	OK	?	?	NO	NO	OK
Ammonium phosphate, mono-basic	NO	?	OK	?	—	?	OK	NO
Ammonium phosphate, di-basic	?	OK	OK	OK	—	?	?	OK
Ammonium phosphate, tri-basic	OK	OK	OK	OK	OK	?	?	OK
Ammonium sulfate	OK	OK	?	OK	OK	?	OK	—
Asphalt	OK	OK	OK	OK	OK	OK	OK	—
Beer (5)	?	?	OK	OK	OK	OK	OK	OK
Beet sugar liquors	OK	OK	OK	OK	OK	?	?	OK
Benzene or benzol	OK	OK	OK	OK	OK	OK	OK	OK
Benzine	OK	OK	OK	OK	OK	OK	OK	OK
Borax	OK	OK	OK	OK	OK	?	?	?
Boric acid	NO	?	OK	OK	OK	?	OK	OK
Butane; butylenes; (6) butadiene	OK	OK	OK	?	?	OK	OK	OK
Calcium bisulfite (7)	NO	NO	OK	NO	NO	NO	?	?
Calcium chloride (8)	OK	OK	?	OK	OK	OK	OK	NO
Calcium hypochlorite	?	?	?	?	?	?	?	—
Cane sugar liquors	OK	OK	OK	OK	OK	OK	OK	OK
Carbolic acid or phenol	?	?	OK	OK	OK	?	?	OK

Fluid Handled	Iron and Steel	Nickel Cast Iron	Stainless Steel (18-8 Mo)	Monel Metal	Nickel	Red Brass	Acid Resisting Bronze	Aluminum
Carbon dioxide, dry	OK	OK	OK	OK	OK	OK	OK	OK
Carbon dioxide, wet	?	?	OK	OK	OK	?	?	OK
Carbon disulfide	OK	OK	OK	?	—	NO	NO	OK
Carbonic acid; carbonated beverages	NO	NO	OK	OK	OK	?	?	OK
Carbon tetrachloride (9)	?	?	?	OK	OK	?	?	?
Chlorine, dry (10)	OK	OK	?	OK	OK	?	?	—
Chlorine, wet (10)	NO	NO	NO	NO	NO	NO	NO	NO
Chlorex	OK	—	—	OK	—	OK	OK	—
Chromic acid (11)	?	?	OK	?	?	NO	?	?
Citric acid	NO	?	OK	OK	OK	?	OK	OK
Coke oven gas	OK	—	OK	?	—	?	?	OK
Copper sulfate (12)	NO	?	OK	?	?	NO	NO	NO
Core oils	OK	—	—	—	—	OK	OK	—
Cottonseed oil	OK	OK	OK	OK	OK	?	OK	—
Cresote, crude	OK	OK	OK	OK	OK	?	OK	OK
Doctor solutions	OK	OK	OK	OK	—	NO	NO	NO
Ethers	—	—	OK	OK	OK	OK	OK	OK
Ethylene glycol	OK	OK	OK	OK	OK	OK	OK	OK
Ferric chloride (13)	NO	NO	NO	NO	NO	NO	NO	NO
Ferric sulfate (12)	NO	NO	OK	?	?	NO	?	NO
Formaldehyde	?	?	OK	OK	OK	OK	OK	OK
Formic acid	NO	—	?	?	?	NO	?	NO
Freon, wet	?	OK	?	OK	OK	OK	OK	OK
Freon, dry	OK	OK	OK	OK	OK	OK	OK	OK
Furfural	OK	—	—	OK	OK	OK	OK	OK
Gasoline, sour	?	?	OK	?	—	NO	NO	OK
Gasoline, refined	OK	OK	OK	OK	—	OK	OK	OK
Gelatine	—	—	OK	OK	OK	NO	?	OK
Glucose	OK	OK	OK	OK	OK	OK	OK	OK
Glue	OK	OK	OK	OK	OK	OK	OK	OK
Glycerine or glycerol	OK	OK	OK	OK	OK	OK	OK	OK
Hydrochloric or muriatic acid (14)	NO	NO	NO	?	?	NO	?	NO

(Concluded on Reference Data 293-294)

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CORROSION RESISTANT METAL SELECTION FOR INDUSTRIAL PIPING

(Concluded from Reference Data 291-292)

Adapted from a table designed by L. G. Vande Bogart, Research Engineer, for Crane Company

KEY: (OK)—Can be used (NO)—Should not be used (?)—Proceed with caution (—)—Information lacking

Fluid Handled	Iron and Steel	Nickel Cast Iron	Stainless Steel (18-8 Mo)	Monel Metal	Nickel	Red Brass	Acid Resisting Bronze	Aluminum
Hydrocyanic acid	?	—	OK	OK	—	—	OK	OK
Hydrofluoric acid (15)	?	NO	NO	?	?	NO	?	NO
Hydrogen gas (16)	OK	OK	OK	OK	OK	OK	OK	OK
Hydrogen peroxide	NO	NO	OK	OK	OK	NO	?	OK
Hydrogen sulfide (17); organic sulfur compounds	OK	OK	OK	?	?	NO	NO	OK
Hydrogen sulfide, wet	?	?	OK	?	?	NO	NO	OK
Lacquers and lacquer solvents	?	OK	OK	OK	OK	OK	OK	OK
Lime-sulfur	OK	OK	OK	OK	OK	NO	NO	—
Magnesium chloride	?	?	?	OK	OK	?	OK	NO
Magnesium hydroxide	OK	OK	OK	OK	OK	?	?	NO
Magnesium sulfate	OK	OK	OK	OK	OK	OK	OK	OK
Mercuric chloride	?	?	NO	?	?	NO	NO	NO
Mercury	OK	OK	OK	OK	OK	NO	NO	NO
Milk	NO	NO	OK	?	OK	NO	NO	OK
Molasses	OK	OK	OK	OK	OK	OK	OK	OK
Natural gas	OK	OK	OK	OK	OK	?	?	OK
Nickel chloride (18)	—	—	?	?	?	NO	NO	NO
Nickel sulphate (18)	—	—	?	?	?	?	?	NO
Nitrating acids (Water<20%; sulfuric>15%)	?	?	?	NO	NO	NO	NO	NO
Nitrating acids (Water>20%; sulfuric<15%)	NO	NO	?	NO	NO	NO	NO	NO
Nitrating acids (Water>20%; nitric<15%)	NO	NO	NO	NO	NO	NO	NO	NO
Nitrating acids (sulfuric+nitric =1% or less)	NO	?	OK	NO	NO	NO	NO	OK
Nitric acid, crude	NO	—	?	NO	NO	NO	NO	?
Nitric acid, pure (19)	NO	—	OK	NO	NO	NO	NO	?
Oleic acid	?	?	OK	OK	—	?	OK	OK
Oxalic acid	?	?	—	OK	—	?	OK	OK
Oxygen	OK	—	OK	OK	—	OK	OK	OK

Fluid Handled	Iron and Steel	Nickel Cast Iron	Stainless Steel (18-8 Mo)	Monel Metal	Nickel	Red Brass	Acid Resisting Bronze	Aluminum
Palmitic acid	?	?	OK	OK	—	?	OK	OK
Petroleum oils, not refined	OK	OK	?	—	—	?	?	—
Petroleum oils, refined	OK	OK	OK	OK	OK	OK	OK	OK
Phosphoric acid, crude	?	—	?	?	?	NO	NO	NO
Phosphoric acid, pure (<45%)	NO	—	OK	?	—	NO	?	NO
Phosphoric acid, pure (<45%, cold)	NO	—	OK	?	—	NO	NO	NO
Phosphoric acid, pure (20) (<45%, hot)	NO	—	?	?	NO	NO	NO	NO
Picric acid (molten)	OK	—	OK	NO	NO	NO	NO	—
Picric acid (aqueous solution)	?	—	OK	NO	NO	NO	NO	OK
Potassium chloride	OK	OK	?	OK	OK	OK	OK	?
Potassium hydroxide	?	OK	?	OK	OK	NO	NO	NO
Potassium sulfate	OK	OK	—	OK	OK	OK	OK	OK
Propane gas (6)	OK	OK	OK	OK	OK	OK	OK	OK
Rosin, dark	OK	OK	OK	OK	OK	?	OK	OK
Rosin, light	NO	?	OK	OK	OK	NO	NO	OK
Shellac, orange	OK	OK	OK	OK	OK	OK	OK	OK
Shellac, bleached	NO	?	OK	OK	OK	?	?	OK
Soda ash or sodium carbonate	OK	OK	OK	OK	OK	?	?	NO
Sodium bicarbonate or baking soda	?	OK	OK	OK	OK	?	OK	?
Sodium bisulfate	NO	?	?	OK	OK	?	OK	?
Sodium chloride	OK	OK	?	OK	OK	OK	OK	?
Sodium cyanide	OK	?	OK	?	?	NO	NO	NO
Sodium hydroxide	OK	OK	?	OK	OK	?	?	NO
Sodium hypochlorite	NO	?	?	?	?	NO	NO	NO
Sodium metaphosphate	?	—	OK	OK	—	?	OK	OK
Sodium nitrate	OK	OK	OK	OK	OK	?	?	OK
Sodium perborate; sodium peroxide	?	OK	OK	OK	OK	?	?	OK
Sodium phosphate, mono-basic	?	—	OK	OK	OK	?	OK	OK

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CORROSION RESISTANT METAL SELECTION FOR INDUSTRIAL PIPING

Adapted from a table designed by L. G. Vande Bogart, Research Engineer, for Crane Company

KEY: (OK)—Can be used (NO)—Should not be used (?)—Proceed with caution (—)—Information lacking

Fluid Handled	Iron and Steel	Nickel Cast Iron	Stainless Steel (18-8 Mo)	Monel Metal	Nickel	Red Brass	Acid Resisting Bronze	Aluminum
Sodium phosphate, di-basic	?	OK	OK	OK	OK	OK	OK	OK
Sodium phosphate, tri-basic	OK	OK	OK	OK	OK	NO	NO	NO
Sodium silicate	OK	OK	OK	OK	OK	NO	NO	NO
Sodium sulfate	OK	OK	?	OK	OK	OK	OK	—
Sodium sulfide	OK	OK	OK	OK	OK	NO	NO	NO
Sodium thiosulfate or hypo	?	—	OK	?	?	NO	NO	?
Sludge acid	NO	?	NO	?	—	NO	?	NO
Stearic acid	?	?	OK	OK	OK	?	?	OK
Sulfate liquors (21)	OK	OK	OK	OK	—	NO	NO	NO
Sulfur	OK	?	?	?	?	NO	NO	OK
Sulfur chloride	?	OK	?	OK	OK	NO	NO	—
Sulfur dioxide, dry (22)	OK	OK	OK	OK	—	OK	OK	OK
Sulfur trioxide, dry (23, 24)	OK	OK	OK	OK	—	OK	OK	OK
Sulfuric acid (23) (98% to fuming)	OK	OK	?	NO	NO	NO	NO	?
Sulfuric acid (25) (75—95%)	OK	—	NO	NO	NO	NO	NO	NO
Sulfuric acid (25) (10—75%)	NO	?	NO	OK	?	NO	?	NO
Sulfuric acid (<10%)	NO	?	?	OK	?	?	OK	NO

Fluid Handled	Iron and Steel	Nickel Cast Iron	Stainless Steel (18-8 Mo)	Monel Metal	Nickel	Red Brass	Acid Resisting Bronze	Aluminum
Sulfurous acid	NO	—	OK	NO	NO	NO	OK	?
Tar	OK	OK	OK	OK	OK	OK	OK	OK
Tartaric acid	NO	?	OK	OK	OK	?	OK	OK
Toluene or toluol	OK	—	—	OK	—	OK	OK	OK
Trichloroethylene (9)	?	?	?	OK	OK	?	?	—
Turpentine	?	OK	OK	OK	—	?	?	OK
Varnish	?	?	OK	OK	OK	?	?	OK
Vegetable oils	OK	OK	OK	OK	OK	OK	OK	OK
Vinegar	?	?	OK	OK	OK	?	?	?
Water, acid mine (containing oxidizing salts)	NO	?	OK	NO	NO	NO	NO	NO
Water, acid mine (no oxidizing salts)	?	OK	NO	OK	OK	?	OK	NO
Water, fresh (boiler feed, etc.)	OK	OK	—	OK	OK	OK	OK	?
Water, distilled (26) (laboratory grade)	NO	NO	OK	?	OK	NO	NO	OK
Water, distilled (return condensate)	OK	OK	OK	OK	OK	OK	OK	OK
Water, salt (sea water, etc.)	?	OK	?	OK	?	OK	OK	?
Whiskey and wines	NO	?	OK	?	OK	?	?	?
Zinc chloride	?	?	NO	OK	—	NO	NO	NO
Zinc sulfate	?	OK	—	OK	—	?	?	—

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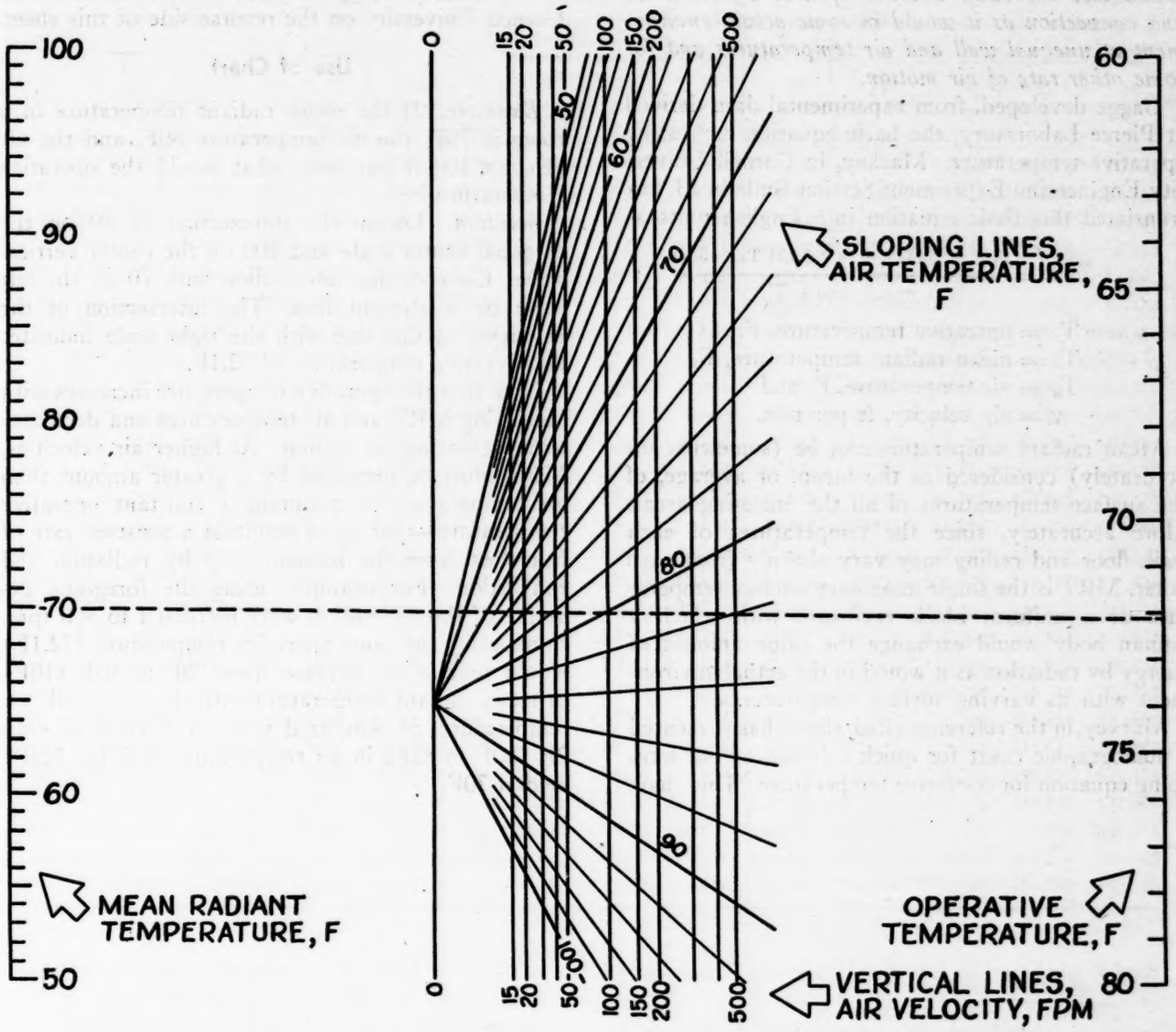
OPERATIVE TEMPERATURE



Since in radiant heating either the wall, ceiling or floor temperature is not at air temperature, the balance between loss of heat from the human body by radiation and convection is not the same as with convection heating. For spaces heated by convection methods *effective temperature,* combining the variables dry and wet bulb temperatures and air motion, has long been used. However, effective temperature was determined by the feeling of comfort of subjects in spaces where the walls were at or approaching air temperature and, consequently, such a measure is of questionable value when applied to a radiant, or panel, heated space.

It is desirable to have a scale to measure physical (not physiological) environment which can be applied to radiant heated enclosures and which will take into account the mean radiant temperature of the enclosing areas, ambient air temperatures, and air motion. Such a scale is found in the *standard operative temperature* developed by Gagge some years ago and reported in his Contribution No. 30 from the John B. Pierce Laboratory of Hygiene.

Operative temperature is that temperature of an imaginary environment in which, with equal wall (enclosing areas) and ambient air temperatures and some standard rate of air motion, the human body

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would lose the same amount of heat by radiation and convection as it would in some actual environment at unequal wall and air temperatures and for some other rate of air motion.

Gagge developed, from experimental data derived at Pierce Laboratory, the basic equation expressing operative temperature. Mackey, in Cornell University Engineering Experiment Station Bulletin 33, has translated this basic equation into English units as

$$T_o = \frac{21.3 + .533T_r + \sqrt{v}\,(.121\,T_a - 5.5)}{.752 + .064\,\sqrt{v}}$$

where T_o = operative temperature, F,
T_r = mean radiant temperature, F,
T_a = air temperature, F, and
v = air velocity, ft per min.

Mean radiant temperature can be (somewhat inaccurately) considered as the mean, or average, of the surface temperatures of all the enclosing areas. More accurately, since the temperatures of each wall, floor and ceiling may vary sharply from each other, MRT is the single imaginary surface temperature of a uniform black enclosure with which a human body would exchange the same amount of energy by radiation as it would in the actual environment with its varying surface temperatures.

Mackey, in the reference cited above, has presented a nomographic chart for quick solution of the foregoing equation for operative temperature. This chart is reproduced by permission of the author and Cornell University on the reverse side of this sheet.

Use of Chart

Example. If the mean radiant temperature in a room is 70F, the air temperature 80F, and the air velocity 100 ft per min, what would the operative temperature be?

Solution. Locate the intersection of 80 on the diagonal center scale and 100 on the center vertical scale. Connect this intersection with 70 on the left scale by a straight line. The intersection of the extension of this line with the right scale indicates an operative temperature of 72.1F.

Note that the operative temperature increases with increasing MRT and air temperatures and decreases with increasing air motion. At higher air velocities, MRT must be increased by a greater amount than air temperature to maintain a constant operative temperature—that is, to maintain a constant rate of heat loss from the human body by radiation and convection. For example, using the foregoing example, if the air motion were increased to 500 fpm, to maintain the same operative temperature (72.1F) would require an increase from 70F to 80F (10F) in mean radiant temperature with the same 80F air temperature, as compared with an increase of only 2F (80F to 82F) in air temperature with the MRT held at 70F.

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TABLE 1.—PIPE SIZING TABLE FOR STEAM MAINS
(with flow in pounds per hour)

Pressure Drop, Ounces per 100 Ft.	Pipe Diameter, Inches															
	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
	Steam Flow, Pounds of Steam per Hour per 100 Ft. of Line															
¼	24.3	48.7	81.4	149	223	314	581	954	1988	3620	5812	7354	10,347	14,125	18,673	30,045
½	34.4	68.8	115	210	315	444	822	1349	2810	5117	8216	10,395	14,696	19,966	26,395	42,469
¾	42.0	84.2	141	257	385	544	1005	1650	3438	6261	10,051	12,717	17,979	24,426	32,292	51,957
1	48.6	97.4	163	297	445	629	1162	1909	3976	7241	11,624	14,707	20,793	28,249	37,346	60,089
1½	59.6	119	200	364	545	771	1425	2339	4873	8874	14,246	18,025	25,483	34,621	45,770	73,643
2	66.7	134	223	408	611	863	1595	2619	5456	9935	15,951	20,181	28,532	38,763	51,246	82,453
3	84.3	169	282	515	771	1090	2015	3308	6891	12,458	20,146	25,489	36,036	48,958	64,724	104,141
4	97.1	194	325	594	888	1255	2320	3810	7937	14,454	23,205	29,359	41,508	56,392	74,552	119,953
5	109	218	364	665	995	1407	2600	4270	8894	16,196	26,002	32,898	46,511	63,189	83,538	134,411
6	119	238	398	728	1089	1539	2845	4672	9731	17,720	28,449	35,994	50,889	69,136	91,400	147,061
7	129	257	431	787	1178	1664	3076	5052	10,523	19,163	30,765	38,924	55,032	74,765	98,842	159,034
8	137	275	460	840	1256	1775	3282	5389	11,226	20,442	32,819	41,523	58,706	79,756	105,440	169,651
9	145	292	488	892	1335	1886	3487	5726	11,929	21,772	34,873	44,121	62,380	84,748	112,039	180,268
10	154	307	514	939	1405	1986	3671	6028	12,556	22,865	36,708	46,444	65,663	89,208	117,936	189,756
12	168	337	563	1029	1539	2175	4020	6602	13,752	25,042	40,204	50,867	71,916	97,704	129,168	207,828
14	182	364	609	1112	1665	2352	4348	7140	14,873	27,084	43,482	55,014	77,779	105,669	139,698	224,771
16	193	387	647	1183	1770	2501	4623	7592	15,815	28,799	46,235	58,497	82,704	112,360	148,543	239,002
18	206	413	691	1262	1889	2669	4934	8102	16,876	30,731	49,337	62,422	88,254	119,900	158,512	255,041
20	218	436	728	1330	1991	2813	5200	8539	17,788	32,392	52,003	65,795	93,022	126,378	167,076	268,821
25	243	467	814	1467	2225	3144	5812	9544	19,881	36,203	58,121	73,536	103,966	141,246	186,732	300,447
30	265	531	887	1621	2426	3428	6337	10,405	21,675	39,469	63,365	80,171	113,347	153,990	203,580	327,555
40	307	615	1028	1878	2811	3972	7342	12,056	25,113	45,370	73,416	92,887	131,326	178,416	235,872	379,512
60	377	754	1261	2303	3447	4870	9002	14,783	30,793	56,073	90,002	113,897	161,030	218,772	289,224	465,354
80	435	871	1457	2661	3982	5626	10,401	17,079	35,576	64,784	104,006	131,590	186,045	252,756	334,152	537,642
100	486	974	1628	2974	4450	6288	11,624	19,088	39,762	72,405	116,242	147,071	207,932	282,492	373,464	600,894
120	532	1065	1781	3253	4868	6879	12,717	20,882	43,499	79,210	127,167	160,894	227,475	309,042	408,564	657,369
160	614	1230	2056	3756	5621	7943	14,683	24,111	50,225	91,459	146,832	184,116	262,651	356,832	471,744	759,024

Table 1 is a tabular solution of Babcock's formula for flow of steam through pipes, with two conditions fixed—initial pressure at 2 lb per sq in and length of line at 100 ft.

Values given in the body of Table 1 are in pounds of steam per hour per 100 ft of line and for an initial pressure of 2 lb gage. The length of the line is the run in feet plus equivalent length of valves and fittings given in Table 4.

For length of pipe other than 100 ft, or for initial steam pressures other than 2 lb gage, multiply the proper value in Table 1 by the factors in Tables 2 and 3, respectively.

USE OF TABLES

Example. What size pipe would be necessary for a straight run of 100 feet with a pressure drop of 1 oz, an initial steam pressure of 2 lb, and a load of 1150 lb of steam per hour?

Solution. Opposite 1 oz in Table 1 find 1162 lb as the nearest figure over 1150, and calling for a 5 inch pipe.

Example. It is desired to convey 790 lb of steam per hour at an initial pressure of 5 lb gage through 800 ft of pipe, with a pressure drop of 4 ounces per 100 ft. What size pipe is necessary?

Solution. From Table 3 find a multiplier of 1.07 for 5 lb pressure, and a multiplier of 0.354 from Table 2 for 800 ft of pipe. Since $0.354 \times 1.07 = .379$, we must look for a number opposite 4 oz in Table 1 which, when multiplied by 0.379 will be close to 790 lb. (For quick inspection use .4.) The figure 790/.379 is 2083 lb, and the nearest larger figure in the 4 oz column of Table 1 is 2320, requiring a 5 inch pipe.

Example. A source of steam is so located that it is 350 feet from the steam utilizing equipment, and in the line is a check valve, a globe valve, a 45° elbow and a 90° elbow. What size pipe will be necessary if the initial pressure is 2 lb per sq in, the pressure

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TABLE 2.—MULTIPLIERS FOR ADJUSTING VALUES IN TABLE FOR LENGTHS OTHER THAN 100 FT.

Equivalent Length of Line, Feet	Multiply Values in Table 1 by
25	2.00
50	1.41
75	1.15
100	1.00
125	0.894
150	0.819
175	0.755
200	0.707
250	0.633
300	0.575
350	0.534
400	0.500
500	0.447
600	0.409
700	0.378
800	0.354
900	0.332
1000	0.316
1250	0.283
1500	0.258
2000	0.224
2500	0.200

For lengths other than given, find the reciprocal, extract the square root, and divide by 0.10. Result is the multiplier.

TABLE 3.—MULTIPLIERS FOR ADJUSTING VALUES FOR INITIAL STEAM PRESSURES OTHER THAN 2 LB. GAGE

Steam Pressure	Multiply Values in Table by
Inches of Mercury, Abs.	
5	0.407
10	0.564
15	0.682
20	0.780
25	0.866
Lb. per Sq. In., Gage	
0	0.945
0.5	0.958
1.0	0.970
1.5	0.995
2.0	1.00
2.5	1.01
5	1.07
10	1.21
15	1.31
20	1.41
25	1.50
30	1.59
40	1.74
50	1.89
60	2.02
75	2.20
100	2.48
125	2.72
150	2.94
200	3.33
250	3.68

For steam pressures other than given, find specific volume (cu. ft. per lb.) from steam tables. Reciprocal is density. Extract square root of density. Divide by 0.2049. Result is multiplier.

drop is not to exceed 2 ounces per 100 ft and the load is 600 lb per hr?

Solution. From Table 2 find opposite 350 ft the multiplier of 0.534. For a trial, use .5 and find, in Table 1, opposite 2 oz, 1595. Now 1595 × .5 or 797 is the nearest larger number to 600 lb. This requires a 5 in. pipe. Now enter Table 4 and find that a 5 inch check valve is equivalent to 32 feet, a 5 inch 45° ell to 6 feet, and a 5 inch 90° ell to 13 feet, a total of 32 + 6 + 13 = 51 feet equivalent length of valves and fittings. Adding this to the straight run of 350 feet gives 401 feet, which we can call 400.

Now check back to Table 2 and find a multiplier of .500 for 400 feet. The figure used as a trial (1595 × .5) or 797 still holds and a 5 inch pipe will be needed. In many cases the second check gives one pipe size difference so that the valve and fitting resistances must be recomputed.

TABLE 4.—EQUIVALENT RESISTANCES OF VALVES AND FITTINGS.

Valve or Fitting	Nominal Diameter of Pipe, Inches																		
	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
	Equivalent Length Straight Pipe, Feet																		
Globe valve	22	27	37	44	55	65	80	100	120	140	160	220	280	340	380	430	500	550	650
Angle valve	12	15	18	21	28	32	41	50	55	70	80	110	140	160	190	220	250	270	380
Swing check valve, open	5	7	9	11	14	15	9	22	25	32	40	50	65	75	90	105	120	130	150
Gate valve, open	0.5	0.6	0.8	0.9	1.2	1.4	1.6	2	2.2	2.9	3.5	4.5	5.5	6.5	8	9	10	12	14
Gate valve, ¼ closed	2.5	3.5	4.5	5.2	7	8	10	12	14	17	20	25	34	40	45	52	60	67	80
Gate valve, ½ closed	14	16	22	25	35	40	50	60	65	80	100	135	165	200	230	260	300	320	400
Gate valve, ¾ closed	55	70	90	110	140	160	200	240	275	325	400	525	700	800	950	1100	1300	1400	1520
Tee	4.5	5.5	7.5	9	12	14	16.5	19	21	27	34	44	55	65	75	88	110	115	135
Elbow, standard	2.0	2.6	3.5	4.5	5.3	6.3	8	9.5	11	13	16	20	25	31	36	40	45	50	60
Elbow, medium sweep	1.7	2.2	3	3.5	4.5	5.3	6.8	8	9	12	14	17	22	25	30	35	40	43	51
Elbow, long sweep	1.4	1.7	2.4	2.8	3.5	4.2	5.1	6	7	9	11	14	17	20	23	25	30	34	40
Elbow, square	4.5	5.5	7.5	9	12	14	16.5	19	21	27	34	44	55	65	75	88	110	115	135
45° elbow	1.0	1.3	1.6	2	2.5	3	3.7	4.4	5	6	7.3	10	13	15	17	19	21	23	29

Notes. Values for closed (180°) return bends, approximately between values for square elbow and check valve.
Values for entrance into pipe (as from tank) approximately between 45° ell and long sweep elbow.
Values for run through a tee, same as long sweep elbow.
Values for run outside outlet of tee, same as for tee.

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SIZING STEAM HEATING MAINS

TABLE 1.—PIPE SIZING TABLE FOR STEAM MAINS.
(In terms of square feet of direct radiator surface served)

Pressure Drop, Ounces per 100 Ft.	Pipe Diameter, Inches															
	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16
	Square Feet Direct Steam Radiator Surface															
¼	14.0	28.4	62.8	92.2	195	326	596	892	1256	2324	3816	7952	14,480	23,248	29,416	41,388
½	19.2	40.4	88.8	138	275	460	840	1260	1776	3288	5396	11,240	20,468	32,864	41,576	58,784
¾	20.0	49.2	109	168	337	564	1028	1540	2176	4020	6600	13,752	25,044	40,204	50,868	71,916
1	28.0	56.8	126	194	390	652	1188	1780	2516	4648	7636	15,904	28,964	46,496	58,828	85,082
1½	34.4	69.6	154	238	476	800	1456	2180	3084	5700	9356	19,492	35,496	56,984	72,100	101,932
2	38.4	78.0	173	267	536	892	1632	2444	3452	6380	10,476	21,324	39,740	63,804	80,724	114,128
3	48.8	98.8	218	327	676	968	2060	3284	4360	8060	13,232	27,564	49,832	80,584	101,956	144,144
4	56.0	114	251	388	776	1300	2376	3552	5020	9280	15,240	31,748	57,816	92,820	117,436	166,032
5	62.8	127	141	436	872	1456	2660	3980	5628	10,400	17,080	34,776	64,744	104,008	131,592	186,044
6	68.8	139	308	476	952	1592	2912	4356	6156	11,380	18,688	38,924	70,880	113,996	143,976	203,556
7	74.4	151	333	516	1028	1724	3148	4712	6656	12,304	20,208	42,092	76,652	123,060	155,696	220,128
8	79.2	161	355	548	1100	1840	3360	5024	7100	13,128	21,556	44,904	81,768	131,276	166,092	234,824
9	84.4	171	378	580	1168	1952	3568	5340	7544	13,948	22,904	47,716	86,888	139,492	176,484	249,520
10	88.8	180	398	616	1228	2056	3756	7025	7944	14,684	24,112	50,224	91,460	146,832	185,776	262,652
12	97.2	197	436	672	1348	2252	4116	6156	8700	16,080	26,408	55,008	100,168	160,016	203,468	287,664
14	105	213	472	728	1456	2436	4448	6660	9408	17,392	28,560	59,492	112,336	173,928	210,056	311,116
16	112	226	500	772	1548	2588	4732	7080	10,004	18,492	30,368	63,260	115,196	184,940	233,988	330,816
18	119	242	536	824	1652	2764	5048	7556	10,676	19,736	32,408	67,504	122,924	317,348	249,688	353,016
20	126	255	564	872	1744	2912	5320	7964	11,262	20,800	34,156	71,152	129,568	208,012	263,180	372,088
25	140	285	628	972	1868	3256	5868	8900	12,576	34,156	38,176	79,524	144,812	232,484	294,144	415,864
30	153	310	688	1060	2124	3548	6484	19,704	13,712	25,347	41,620	86,700	157,876	253,460	320,684	453,388
40	178	352	796	1228	2460	4112	7512	11,244	15,888	29,368	48,224	100,452	182,920	293,664	370,748	525,304
60	218	440	966	1508	3016	5044	9212	13,788	19,480	36,008	55,132	123,172	224,292	360,088	455,588	644,120
80	251	508	1128	2175	3508	5828	10,644	15,928	22,504	11,604	68,316	142,304	259,136	416,024	526,360	744,180
100	281	568	1260	1944	3896	6512	11,896	17,800	25,152	46,496	76,352	159,048	289,620	464,968	588,284	831,728

Table 1 is a tabular solution of Babcock's formula for flow of steam through pipes with the flow expressed in square feet of radiator served. The data are suitable for sizing all dripped horizontal steam mains and branches, and down feed risers. They are not recommended for lines where the condensation flows opposite to the steam flow. The figures given in Table 1 are based on an initial pressure of 2 lb per sq in gage and a length of line of 100 ft. The length of pipe in any given case is the run in feet plus the equivalent length of valves and fittings given in Table 4.

For length of pipe other than 100 ft, or for initial steam pressures other than 2 lb gage, multiply the proper value in Table 1 by the factors in Tables 2 and 3, respectively.

USE OF TABLES

Example. A steam main runs from a low pressure heating boiler in a straight line to a riser 50 ft away and serving 600 sq ft of radiator; 25 feet further a second riser serves 1000 sq ft of radiator; 50 ft further a riser serves 800 sq ft. What size should the different sections of the main be if the allowable pressure drop is 1 oz for each section?

Solution. Since the boiler is of the low pressure heating type, a gage pressure of 2 lb applies and Table 1 will be suitable after length adjustment is made. The section from the boiler to the first riser carries steam for 600 + 1000 + 800 = 2400 sq ft and is 50 ft away. From Table 2, the multiplier for 50 ft is 1.41.

We must select the pipe in Table 1, opposite 1 oz, which gives a value which when multiplied by 1.41 is next above 2400. As a trial use 1780, for a 3½ inch pipe. 1780 × 1.41 = 2510. Consequently the first section should be 3½ inch pipe.

The second section, 25 ft long, serves 1000 + 800 = 1800 sq ft. From Table 2, the length multiplier is 2.0. In the 1 oz column of Table 1 find 652 (3 inch pipe). Now 652 × 2 = 1304 (too small) while 1780 × 2 = 3560, well over 1800, so that this section should be 3 inch pipe.

The final run of 50 ft, with a multiplier of 1.41 and a load of 800 sq ft, calls for a 2½ inch pipe, for 652 × 1.41 = 919, well over 800.

Example. A horizontal steam main connects a boiler and a riser connected to 2700 sq ft of radiator. The main contains a gate valve, two 90° standard ells and a 45° ell, and is 138 ft long. What size pipe is required if the allowable pressure drop is 1 oz per 100 ft and the pressure is 5 lb gage?

Solution. From Table 1 opposite 1 oz find 4648 as the nearest larger number to 2700, and calling for a 5 inch main. From Table 4 a 5 inch gate valve, open, has an equivalent length of 2.9 ft; two stand-

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TABLE 2.—MULTIPLIERS FOR ADJUSTING VALUES IN TABLE FOR LENGTHS OTHER THAN 100 FT.

Equivalent Length of Line, Feet	Multiply Values in Table 1 by
25	2.00
50	1.41
75	1.15
100	1.00
125	0.894
150	0.819
175	0.755
200	0.707
250	0.633
300	0.575
350	0.534
400	0.500
500	0.447
600	0.409
700	0.378
800	0.354
900	0.332
1000	0.316
1250	0.283
1500	0.258
2000	0.224
2500	0.200

For lengths other than given, find the reciprocal, extract the square root, and divide by 0.10. Result is the multiplier.

TABLE 3.—MULTIPLIERS FOR ADJUSTING VALUES FOR INITIAL STEAM PRESSURES OTHER THAN 2 LB. GAGE

Steam Pressure	Multiply Values in Table by
Inches of Mercury, Abs.	
5	0.407
10	0.564
15	0.682
20	0.780
25	0.866
Lb. per Sq. In., Gage	
0	0.945
0.5	0.958
1.0	0.970
1.5	0.995
2.0	1.00
2.5	1.01
5	1.07
10	1.21
15	1.31
20	1.41
25	1.50
30	1.59
40	1.74
50	1.89
60	2.02
75	2.20
100	2.48
125	2.72
150	2.94
200	3.33
250	3.68

For steam pressures other than given, find specific volume (cu. ft. per lb.) from steam tables. Reciprocal is density. Extract square root of density. Divide by 0.2049. Result is multiplier.

ard 90° ells, 5 inch, a length of 26 ft, and a 5 inch 45° ell, 6 ft. Totaling we have $3 + 26 + 6 = 35$ ft. Adding this to the 138 ft run gives 173 ft. This is very close to 175, and opposite that number in Table 2 find .755. From Table 3, for 5 lb, the multiplier is 1.07 and $1.07 \times .755 = .808$. Consequently, in the 1 oz column of Table 1 find a number which when multiplied by .808 is larger than 2700, or, if $x =$ this number, then $.808x = 2700$ or

$$x = \frac{2700}{.808} = 3350.$$

Refer again to Table 1, opposite 1 oz, and find that 3350 is smaller than 4648, so that the 5 inch pipe is satisfactory. In many cases the second check gives one pipe size difference so that the valve and fitting resistance must be recomputed.

TABLE 4.—EQUIVALENT RESISTANCES OF VALVES AND FITTINGS.

Valve or Fitting	Nominal Diameter of Pipe, Inches																		
	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
	Equivalent Length Straight Pipe, Feet																		
Globe valve	22	27	37	44	55	65	80	100	120	140	160	220	280	340	380	430	500	550	650
Angle valve	12	15	18	21	28	32	41	50	55	70	80	110	140	160	190	220	250	270	380
Swing check valve, open	5	7	9	11	14	15	9	22	25	32	40	50	65	75	90	105	120	130	150
Gate valve, open	0.5	0.6	0.8	0.9	1.2	1.4	1.6	2	2.2	2.9	3.5	4.5	5.5	6.5	8	9	10	12	14
Gate valve, ¼ closed	2.5	3.5	4.5	5.2	7	8	10	12	14	17	20	25	34	40	45	52	60	67	80
Gate valve, ½ closed	14	16	22	25	35	40	50	60	65	80	100	135	165	200	230	260	300	320	400
Gate valve, ¾ closed	55	70	90	110	140	160	200	240	275	325	400	525	700	800	950	1100	1300	1400	1520
Tee	4.5	5.5	7.5	9	12	14	16.5	19	21	27	34	44	55	65	75	88	110	115	135
Elbow, standard	2.0	2.6	3.5	4.5	5.3	6.3	8	9.5	11	13	16	20	25	31	36	40	45	50	60
Elbow, medium sweep	1.7	2.2	3	3.5	4.5	5.3	6.8	8	9	12	14	17	22	25	30	35	40	43	51
Elbow, long sweep	1.4	1.7	2.4	2.8	3.5	4.2	5.1	6	7	9	11	14	17	20	23	25	30	34	40
Elbow, square	4.5	5.5	7.5	9	12	14	16.5	19	21	27	34	44	55	65	75	88	110	115	135
45° elbow	1.0	1.3	1.6	2	2.5	3	3.7	4.4	5	6	7.3	10	13	15	17	19	21	23	29

Notes. Values for closed (180°) return bends, approximately between values for square elbow and check valve.
Values for entrance into pipe (as from tank) approximately between 45° ell and long sweep elbow.
Values for run through a tee, same as long sweep elbow.
Values for run outside outlet of tee, same as for tee.

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WATER PIPING DEMAND – 1

A difficult problem in design of hot or cold water supply in buildings is the selection of the most economical pipe size that will assure adequate water supply at all outlets at all times, and at the same time be satisfactory not only when new but in years to come when the capacity of the piping is decreased by deterioration.

The National Bureau of Standards has investigated this phase of design and has developed, under the authorship of Roy B. Hunter, data on this subject.

This sheet, together with the Reference Data 303-304, covers a condensation of the Bureau's method, arranged in step-by-step form.

Selecting pipe sizes for hot and cold water supply systems in buildings involves following procedure:

A. Estimating probable maximum demand on mains and branches;

B. From layout of building and fixture locations, determining equivalent length of different parts of the system;

C. Estimating pressure available for friction loss in system, first having determined minimum pressure in street main or other source of supply, difference in static head between street main and highest fixture, minimum allowable pressure at highest fixture, and friction loss through meter;

D. Selection of kind of pipe—steel, wrought iron, copper or brass—depending on effects of local water on each and consequent life and capacity together with cost of each kind;

E. Selection of proper flow formula or flow chart, depending on kind of pipe and effect of water on it;

F. Selection of pipe size from formula or flow chart, beginning with main and on through each riser and branch.

Maximum Demand. The peak demand of any given fixture is easy to determine by simple tests. The problem is to determine maximum demand of system. By applying probability theory to problem and by making certain assumptions, it is possible to arrive at probability of a certain number of fixtures operating simultaneously at any given instant. The maximum demand on the system then becomes a matter not only of how many of these fixtures will operate simultaneously but also of taking into account relative demand of each. In method presented here, each type of fixture has been assigned a fixture weight; for example, a private lavatory has a weight of 1 and a private water closet with flush tank a weight of 3. This means that latter will, on an average, require three times the flow of former, for purposes of these calculations.

Knowing total number of weighted fixture units, total demand in gallons per minute is determined by reference to suitable curves.

Tables 1A and 1B give the demand weights of fixtures in fixture units. Table 1A is devoted to public occupancy buildings, such as office buildings; the word *public* is applied here as meaning fixtures individually open at all times when the building is open, as in public buildings and office buildings. *Private* refers to fixtures in groups installed so that the entire group may be and generally is confined to the use of one person at a time, as in residences, apartments, or private baths in hotels. The word *total* in these tables refers to hot and cold supply combined. *Hot or cold* refers to hot or cold supply only.

Since flush tank water closets have a lower maximum demand than flush valve fixtures, two curves are presented for determining the total maximum flow once the fixture weights are totaled, as shown in Fig. 1. In lower region, upper curve is for systems predominantly of flush valves, lower for systems principally of flush tanks; in upper region the two curves merge and become one. Fig. 2 is a section of lower portion of Fig. 1 on an enlarged scale, presented for greater ease and accuracy of use when fixture units total less than 240. To use these graphs, enter at horizontal scale and move vertically to intersection with proper curve, then follow horizontally to scale showing demand in gallons per minute.

The purpose of Figs. 1 and 2 is to estimate the maximum demand of the (briefly) intermittently operating fixtures only. Devices or fixtures which impose a relatively continuous demand of water—such as garden hose outlets,

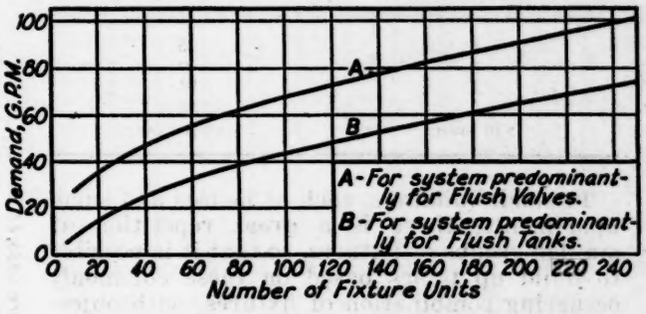

Fig. 1. Chart for determining estimated maximum demand of intermittently operated fixtures when the number of fixture units is less than 240.

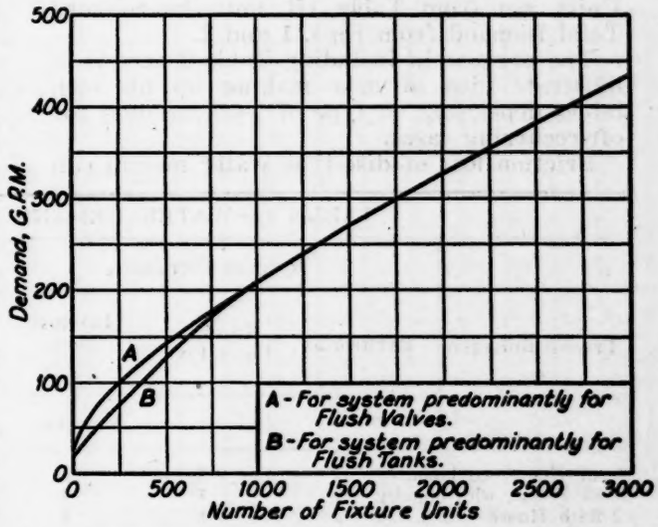

Fig. 2. Chart for determining estimated maximum demand of intermittently operated fixtures when the number of fixture units is over 240.

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TABLE 1A.—DEMAND WEIGHTS OF FIXTURES IN FIXTURE UNITS FOR PUBLIC OCCUPANCY[1]

Fixture[2]	Type of Supply Control	Weight in Fixture Units[3]
Water closet	Flush valve	10
Water closet	Flush tank	5
Pedestal urinal	Flush valve	10
Stall or wall urinal	Flush valve	5
Stall or wall urinal	Flush tank	3
Lavatory	Faucet	2
Bathtub	Faucet	4
Shower head	Mixing valve	4
Service sink	Faucet	3
Hotel or restaurant kitchen sink	Faucet	4

TABLE 1B.—DEMAND WEIGHTS OF FIXTURES IN FIXTURE UNITS FOR PRIVATE OCCUPANCY[1]

Fixture or Group[2]	Type of Supply Control	Weight in Fixture Units[3]
Water closet	Flush valve	6
Water closet	Flush tank	3
Lavatory	Faucet	1
Bathtub	Faucet	2
Shower head	Mixing valve	2
Bathroom group	Flush valve closet	8
Bathroom group	Flush tank closet	6
Separate shower	Mixing valve	2
Kitchen sink	Faucet	2
Laundry tubs (1-3)	Faucet	3
Combination fixture	Faucet	3

[1]For supply outlets which impose a continuous demand, estimate demand and add to the total demand *after* reference to the curve.

[2]For fixtures not listed, assume the weights by comparison to those listed using approximately similar quantities at similar weights.

[3]Given weights are for total demand. For fixtures with both hot and cold water supplies the weights for maximum separate demand may be taken as ¾ the listed demand for the supply.

air conditioning apparatus, and the like—are to be taken into account and added *after* referring to curves. In this connection suggested figures for total demands of *garden hose* connections are:

Number of Outlets	Demand, Gpm
1	5
2	9
3	12
4	14
5 or more	3 gpm per outlet

In small buildings, such as houses and small apartments, there is a great repetition of similar groups of fixtures, so that it is possible to build up tables based on these commonly occurring combination of fixtures, with objective of saving time and work. Table 2 is such a table which covers some of the cases which will be frequently encountered in this smaller type of installation.

In Table 2, columns headed Total Fixture Units are from Table 1B, and the columns Total Demand from Figs. 1 and 2.

The purpose in including Table 2 here is to illustrate idea of user making up his own tables depending on type of work he does for oft-recurring cases.

Friction loss of disc-type water meters can be estimated from Fig. 3. For other types, data must be secured elsewhere.

Step-by-step application of foregoing data appears on Reference Data 303-304.

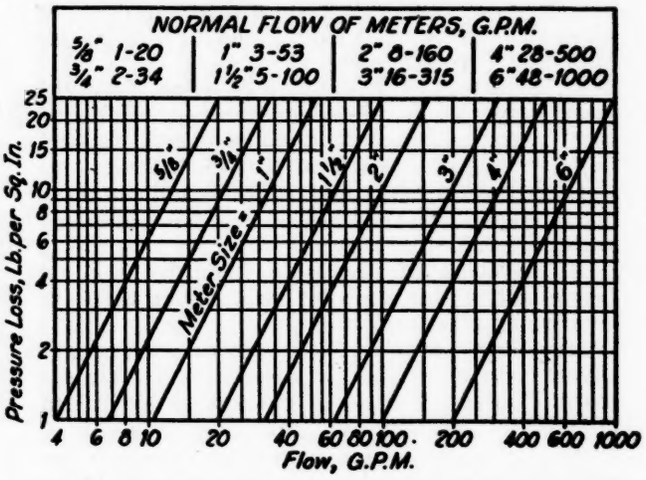

Fig. 3. Chart for determining pressure loss in water meters. Select the size from the size meters from table at the top depending on total estimated maximum flow in gallons per minute. Then enter lower scale of chart at figure representing this flow and move vertically to line indicating the size of meter selected and opposite intersection on vertical scale find pressure loss.

TABLE 2.—WATER DEMAND FOR TYPICAL BUILDINGS

Type of Building	Kinds of Fixtures			Total Fixture Units		Total Demand	
	Bathrooms	Sinks or Comb. Fixt.	Laundry Trays (1-3)	With Flush Valves for W.C.	With Flush Tanks for W.C.	With Flush Valves for W.C.	With Flush Tanks for W.C.
	Number					G.P.M.	
Small House, no laundry	1	1	0	10	8	27	6
Small House, with laundry	1	1	1	13	11	30	8
2-Bath House	2	1	1	21	17	36	12
3-Bath House	3	2	1	31	25	42	17
4-Bath Flat	4	4	2	46	38	49	24
8-Bath Flat	8	8	3	89	73	64	36
16-Bath Flat	16	16	4	172	140	84	52

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This sheet is a companion to Reference Data 301-302 and shows step-by-step application of the data appearing on that sheet and others. Tables 1A, 1B, and 2, Figs. 1, 2 and 3 referred to in this sheet appear on 301-302.

Application of Data

1. By reference to Table 1A if the project is public (as previously defined), Table 1B if the project is private, determine the weight in fixture units for each fixture on the line being calculated. Total these fixture units.

2. If the total from Step 1 is less than 240, use Fig. 2, if greater than 240, use Fig. 1, and, entering drawing with total number of fixture units, locate intersection with Curve A if closets are predominantly of flush valve type or Curve B if of tank type. From intersection move horizontally to vertical scale and find maximum demand of intermittent fixtures.

3. To figure obtained in Step 2 add demand (in gpm) of continuous fixtures or devices such as hose outlets, air conditioning apparatus, etc. The total is total estimated maximum demand.

Subsequent steps are rather simple. Steps 4 to 13 follow:

4. Obtain an estimate of minimum daily service water pressure; this can usually be found by reference to the water utility in the particular area.

5. From plans of the building, measure difference in elevation between water main and highest fixture in the building. Multiply this difference, in feet, by 0.434 to reduce it to static head in pounds per square inch.

6. If a water meter is to be installed, estimate the friction loss, using Fig. 3 where possible.

7. Decide what the minimum pressure should be at highest fixture for satisfactory operation. This should not be less than 15 lb per sq in. for flush valves or 8 to 10 lb for faucets and flush tanks.

TABLE 3.—EQUIVALENT LENGTH OF PIPE FOR FRICTION LOSS IN VALVES AND THREADED FITTINGS

Diameter of Fitting, Inches	90° Standard Ell	45° Standard Ell	90° Side Tee	Coupling or Straight Run of Tee	Gate Valve	Globe Valve	Angle Valve
	Equivalent Length of Pipe for Various Fittings, Feet						
⅜	1	0.6	1.5	0.3	0.2	8	4
½	2	1.2	3	0.6	0.4	15	8
¾	2.5	1.5	4	0.8	0.5	20	12
1	3	1.8	5	0.9	0.6	25	15
1¼	4	2.4	6	1.2	0.8	35	18
1½	5	3	7	1.5	1.0	45	22
2	7	4	10	2	1.3	55	28
2½	8	5	12	2.5	1.6	65	34
3	10	6	15	3	2	80	40
3½	12	7	18	3.6	2.4	100	50
4	14	8	21	4	2.7	125	55
5	17	10	25	5	3.3	140	70
6	20	12	30	6	4	165	80

TABLE 4.—ACTUAL DIAMETERS CORRESPONDING TO NOMINAL DIAMETERS OF DIFFERENT KINDS OF PIPE

Nominal Diameters, Inches	Types of Copper Tubing			Steel or Wrought Iron		Brass (I.P.S.)	
	K	L	M	Standard	Extra Strong	Standard	Extra Strong
	Actual Inside Diameters, Inches						
⅜	0.40	0.43	0.45	0.49	0.42	0.49	0.42
½	0.53	0.55	0.57	0.62	0.55	0.63	0.54
¾	0.75	0.79	0.81	0.82	0.74	0.82	0.74
1	1.00	1.03	1.06	1.05	0.96	1.06	0.95
1¼	1.25	1.27	1.29	1.38	1.28	1.37	1.27
1½	1.48	1.51	1.53	1.61	1.50	1.60	1.49
2	1.96	1.99	2.01	2.07	1.94	2.06	1.93
2½	2.44	2.47	2.50	2.47	2.32	2.50	2.32
3	2.91	2.95	2.98	3.07	2.90	3.06	2.89
3½	3.39	3.43	3.47	3.53	3.36	3.50	3.36
4	3.86	3.91	3.94	4.03	3.83	4.00	3.82
5	4.81	4.88	4.91	5.05	4.81	5.06	4.81
6	5.74	5.85	5.88	6.07	5.76	6.13	5.75

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8. Add static head from Step 5, water meter loss from Step 6, and minimum satisfactory pressure from Step 7. This total is pressure required at the meter entrance if there were no piping friction loss.

9. Subtract total, Step 8, from available minimum service pressure, Step 4. Result is pressure available for friction loss through piping and fittings.

10. Measure length in feet of run of main or branch being calculated. This is a straight measurement from plans and elevations, if they exist, but do not forget to include the length of the vertical risers which may not appear on plans.

11. Estimate equivalent length of fittings in line under consideration by reference to Table 3. Table 3 applies when the workmanship is reasonably good and to non-recessed threaded fittings. For recessed fittings or streamline soldered fittings, use one-half the values in Table 3.

12. Add the equivalent length from Step 11 to the actual measured pipe length from Step 10. The result is the equivalent total length of pipe in the line being calculated.

13. Divide the total pressure available for friction loss from Step 9 by the total equivalent length of pipe from Step 12. Multiply by 100. The result is the permissible friction loss per 100 ft of pipe.

14. The next step involves selection of the pipe and estimates on the pipe friction loss, taking caking and roughness after a few years of operation into account. Refer to Reference Data 231-232 and 233-234. It can be assumed that ferrous pipe after a few years' service with the best of water will have passed from the fairly smooth (Reference Data 232) to the fairly rough (Reference Data 233) class and that (Reference Data 234) with service for a few years with badly corrosive or caking water ferrous pipe will pass from the fairly smooth to the rough category (Reference Data 234).

Ordinarily, with respect to allowances for decrease in capacity, the drop in capacity from caking with hard waters will be relatively greater in (1) smaller pipe sizes than the larger, and (2) hot water lines than in cold water pipes.

Consequently, depending on your selection of kind of pipe and water available in area in question, decide which of flow charts, Reference Data 231 to 234, is applicable to your case.

15. Having decided on proper chart, enter vertical scale with total estimated flow under maximum demand from Step 3. Enter horizontal scale with friction loss per 100 ft of pipe, from Step 13. The intersection of two will indicate, on diagonal scales, (1) actual diameter of pipe to be used and (2) velocity, in feet per second, of flow through pipe during maximum demand. If diameter falls between two sizes, use larger. If velocity is over 15 ft per second, use a larger size, as noise may be objectionable.

16. Using same friction loss (from Step 13) and estimated demand load for each branch, determine in same way sizes of the branches.

Typical Problem

Example: What will be the size of water main, to first branch, supplying an office building with 100 flush valve water closets, 25 flush valve stall urinals, 100 lavatories, and with an air-cooling system using 225 gpm? Building is located in a community with a water which cakes badly; steel pipe is to be used, highest fixture is 30 ft above meter, service water pressure is 85 lb per sq in., measured length of piping is 840 ft and equivalent length of fittings is 395 ft.

Solution: Step 1. Total fixture units based on Table 1A: $(100 \times 10) + (25 \times 5) + (100 \times 2) = 1325$.

Step 2. Referring to Curve A, Fig. 1, for 1325 units, find 250 gpm.

Step 3. Add to this 225 gpm for the cooling unit; total, 475 gpm.

Step 4. Water pressure, given, is 45 lb per sq in.

Step 5. Static head is $.434 \times 30$ ft (given) or 13 lb per sq in.

Step 6. Refer to Fig. 3. Since total flow is 475 gal, this calls for a 6-in. meter. Curve shows pressure loss for this meter and flow to be 5.5 lb per sq in.

Step 7. For flush valves, minimum pressure is 15 lb per sq in.

Step 8. Adding results from Steps 5, 6 and 7:
$13 + 5.5 + 15 = 33.5$ lb per sq in.

Step 9. Subtracting this from service pressure, Step 4, we have $85 - 33.5 = 51.5$ lb per sq in. available piping loss.

Step 10. Length of pipe, 840 ft, given.

Step 11. Equivalent length of fittings, 395 ft, given.

Step 12. Total equivalent length (Step 10 + Step 11) is $840 + 395 = 1235$ ft.

Step 13. Divide available pressure from Step 9 by total equivalent length from Step 12 (or $51.5 \div 1235$) and multiply by 100, giving 5.14 lb per sq in. per 100 ft friction loss.

Step 14. For steel pipe with highly caking water use chart on Reference Data 234.

Step 15. Above 5.14 and opposite 475 (from Step 3) find that a 5-in. main is required to first branch. Velocity is found to be 8 fps. This is not over 15 and therefore the 5-inch pipe is suitable.

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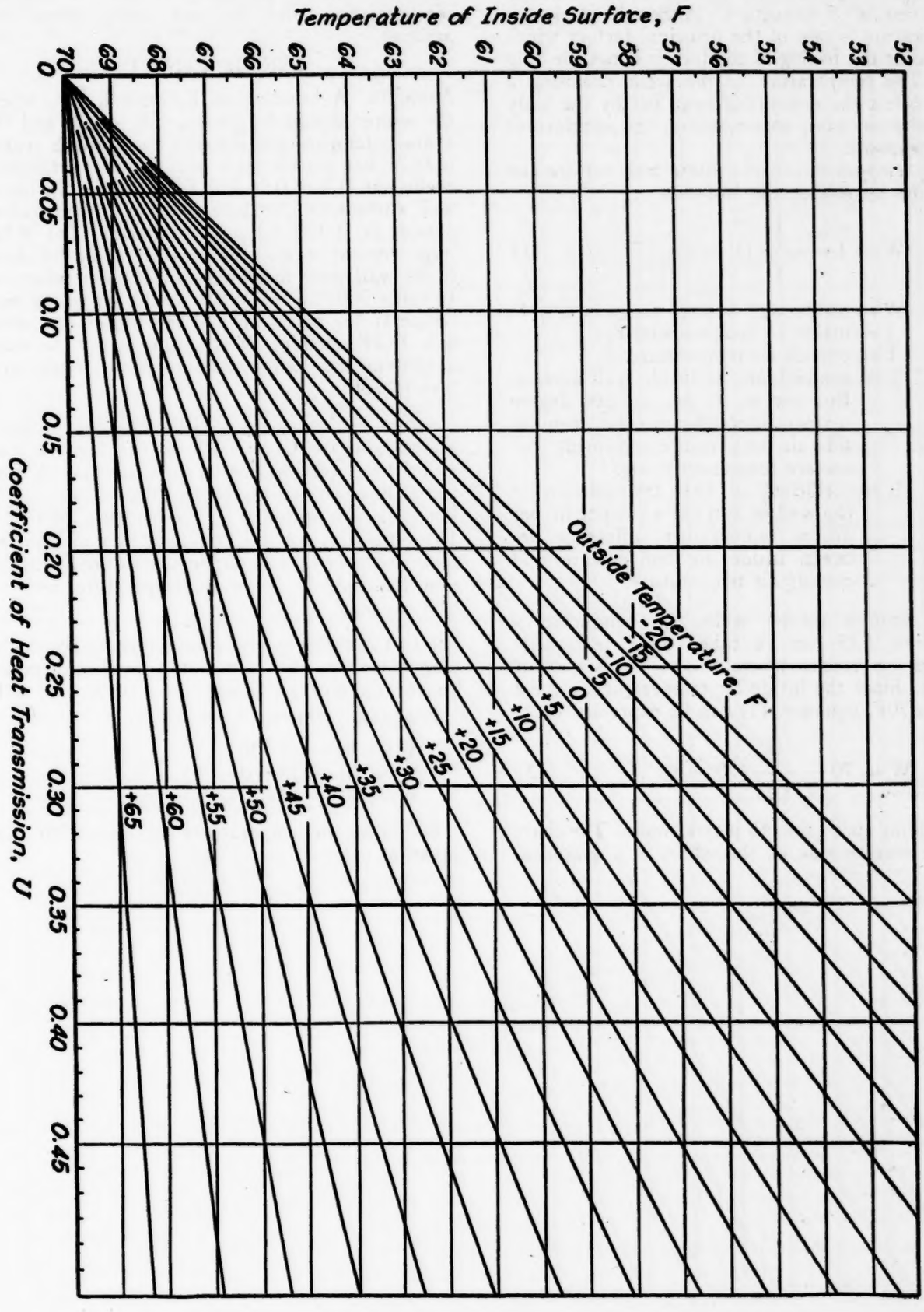
INSIDE WALL SURFACE TEMPERATURES



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INSIDE WALL SURFACE TEMPERATURES

It is frequently desirable to know what inside wall surface temperatures will prevail in a building of a certain construction. Although inside air temperature is one of the principal factors which determine the feeling of comfort, it is not the only one. The temperature of the walls enclosing a space affect the amount of heat lost by the body by radiation and, consequently, the comfort of the occupants.

The temperature of the inside wall surface can be found by solving the equation

$$W = I - \frac{U}{S}(I - T) \quad \ldots\ldots (1)$$

where W = inside wall surface temperature, F,
I = inside air temperature, F,
T = outside air temperature, F,
S = conductance of inside wall surface, Btu per sq ft per hr per degree temperature difference between inside air temperature and inside wall surface temperature, and
U = coefficient of heat transmission of the wall in Btu per sq ft per hr per degree temperature difference between inside air temperature and outside air temperature.

For smooth plaster walls the conductances vary, but 1.75 can be taken as a reasonable average for rooms where there is a slight air motion. Since the inside air temperature in most cases is 70F, equation (1) can be expressed as

$$W = 70 - \frac{U}{1.75}(70 - T) \quad \ldots\ldots (2)$$

for buildings with smooth plaster walls. The chart on the reverse side of this sheet is a graphical solution of equation (2). It can be used for both extreme outside air temperatures or average temperatures, time lag not being taken into account.

USE OF CHART

Example. A building in Richmond, Va., where the winter design temperature is +10F and the average temperature through the heating season is 48.2F has outside walls with a heat transmission coefficient (U) of 0.24. (a) What will be the inside wall surface temperature when the temperature outside is +10F (design condition)? (b) What improvement in wall temperature could be made if the wall were insulated to the point where its U value is 0.06? (c) What would the inside wall temperatures be on an average winter day when it is 48.2F outside? It is assumed that the walls are of smooth plaster and the inside air temperature is 70F.

Solution. (a) Locate +10F on the diagonal scales. Locate U = 0.24 on the bottom scale and draw a vertical line to the diagonal. A horizontal line through the intersection shows, on the left scale, an inside wall temperature of 61.8F. (b) Similarly, for a U of 0.06, find on the left scale as shown, a wall temperature of 68F. Insulation has raised the wall temperature 68.0 — 61.8 = 6.2F.

(c) In the same manner, but using 48.2F on the diagonal scale, the uninsulated temperatures for an average day are found to be 66.2F and 69F.

For glass surfaces, use the following equations:

$W = 70 - .63\,(70 - T)$ ..... single glass
$W = 70 - .26\,(70 - T)$ ..... double glass
$W = 70 - .16\,(70 - T)$ ..... triple glass

For inside air temperatures other than 70F, use equation (1).

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SIZING JOB-MADE LIQUID-VAPOR HEAT EXCHANGERS

This sheet is a companion to Reference Data 275-276 and 277-278. Use of the accompanying charts is explained on Reference Data 275-276.

The charts were designed by William Parkerson, Central Power and Light Company, Victoria, Texas.

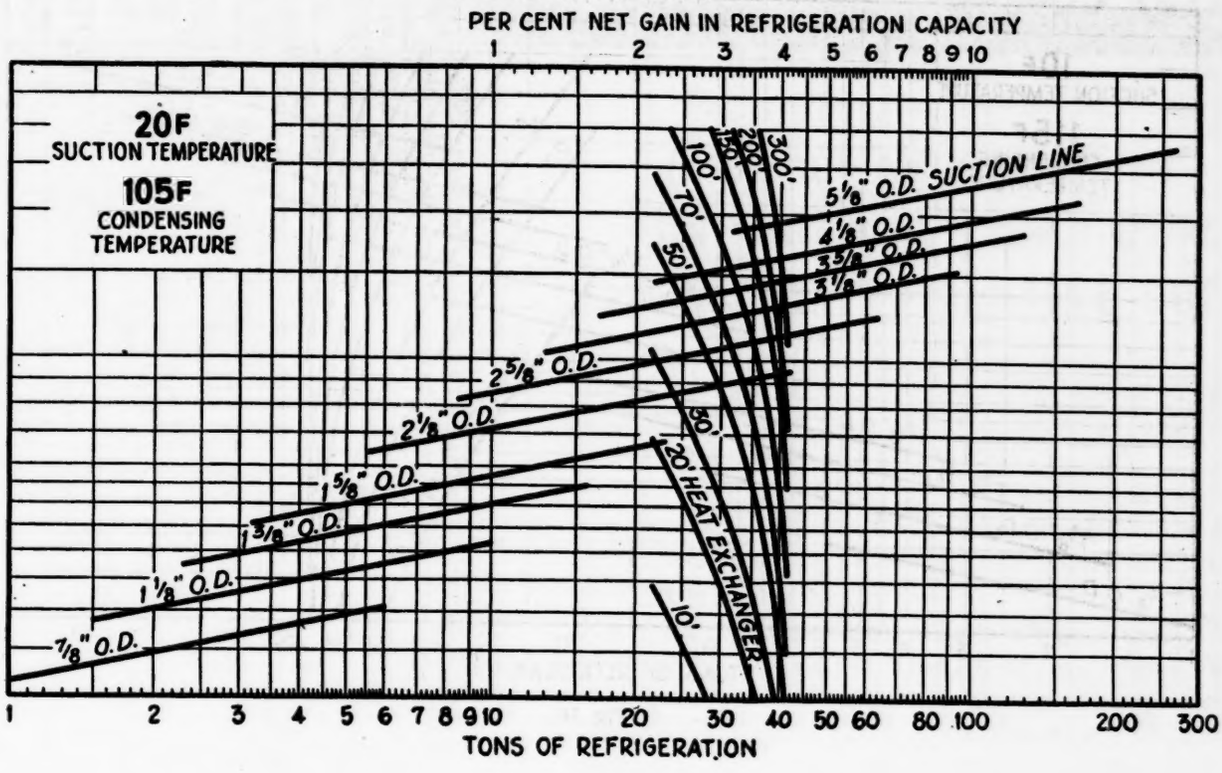

Fig. 8

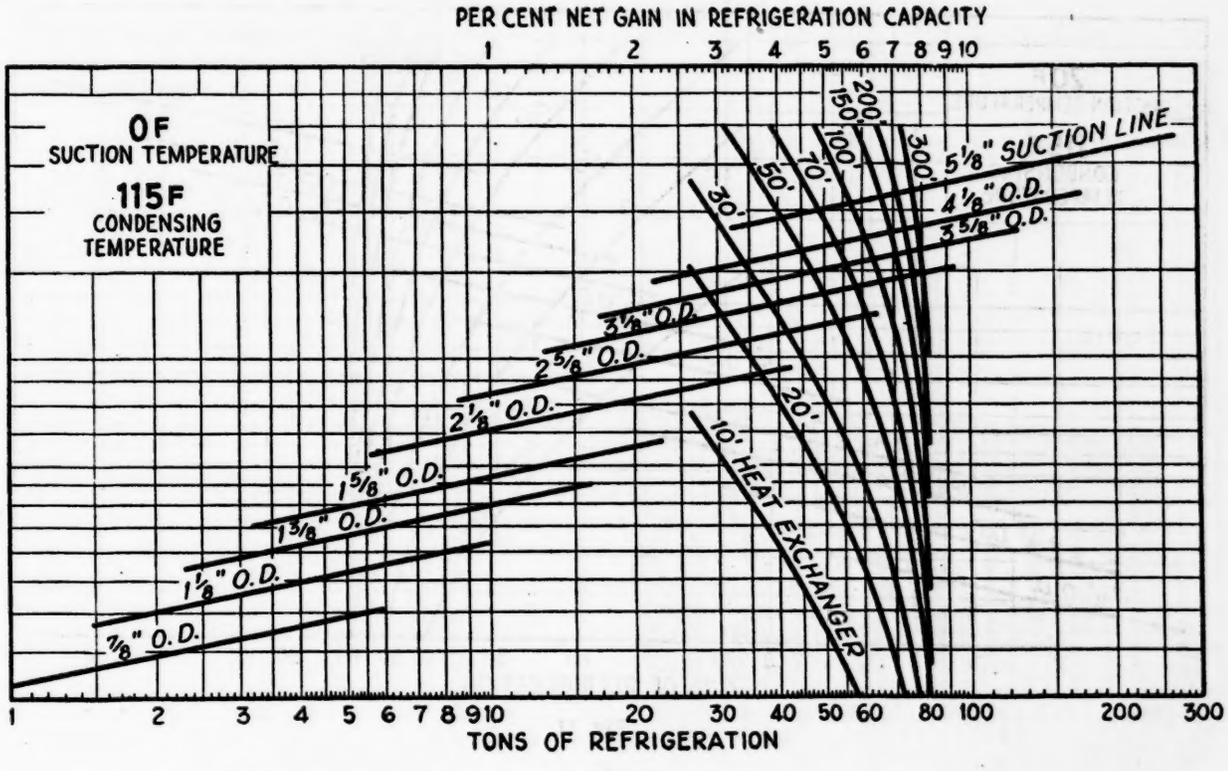

Fig. 9

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SIZING JOB-MADE LIQUID-VAPOR HEAT EXCHANGERS

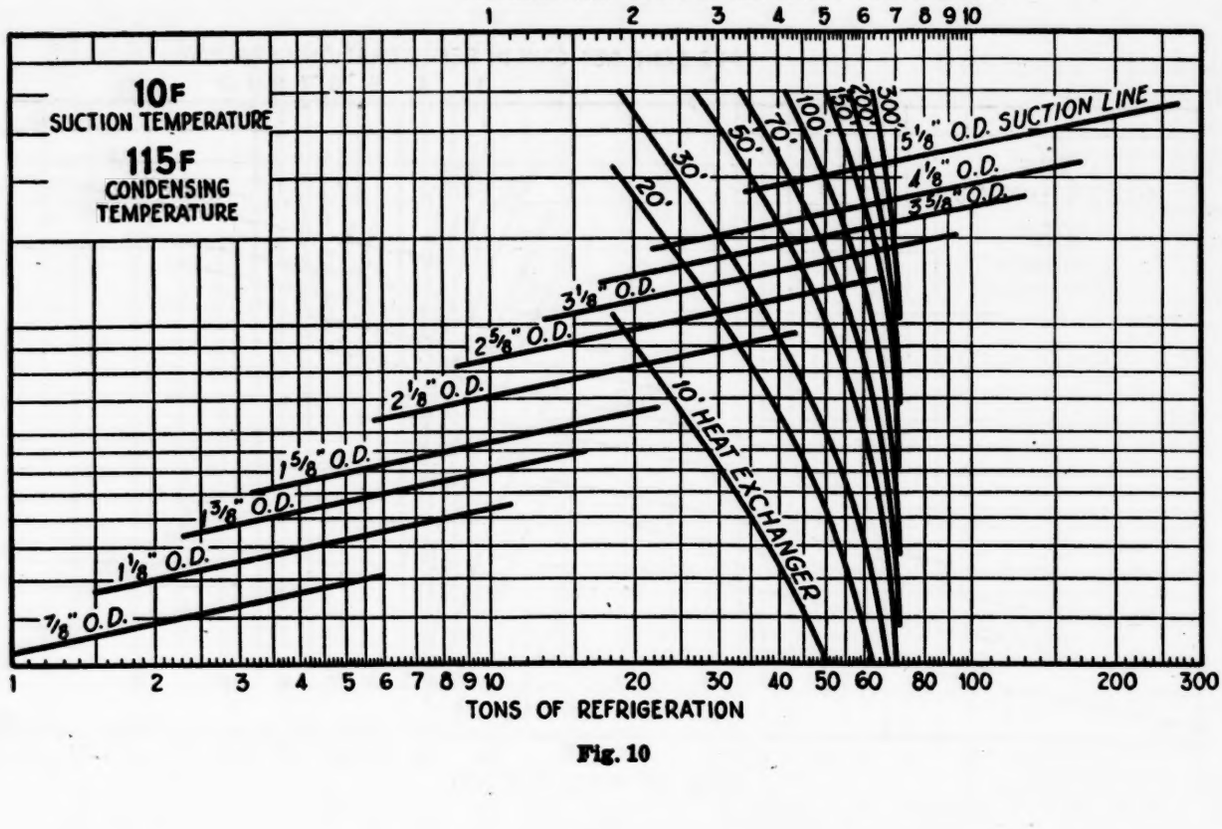

Fig. 10

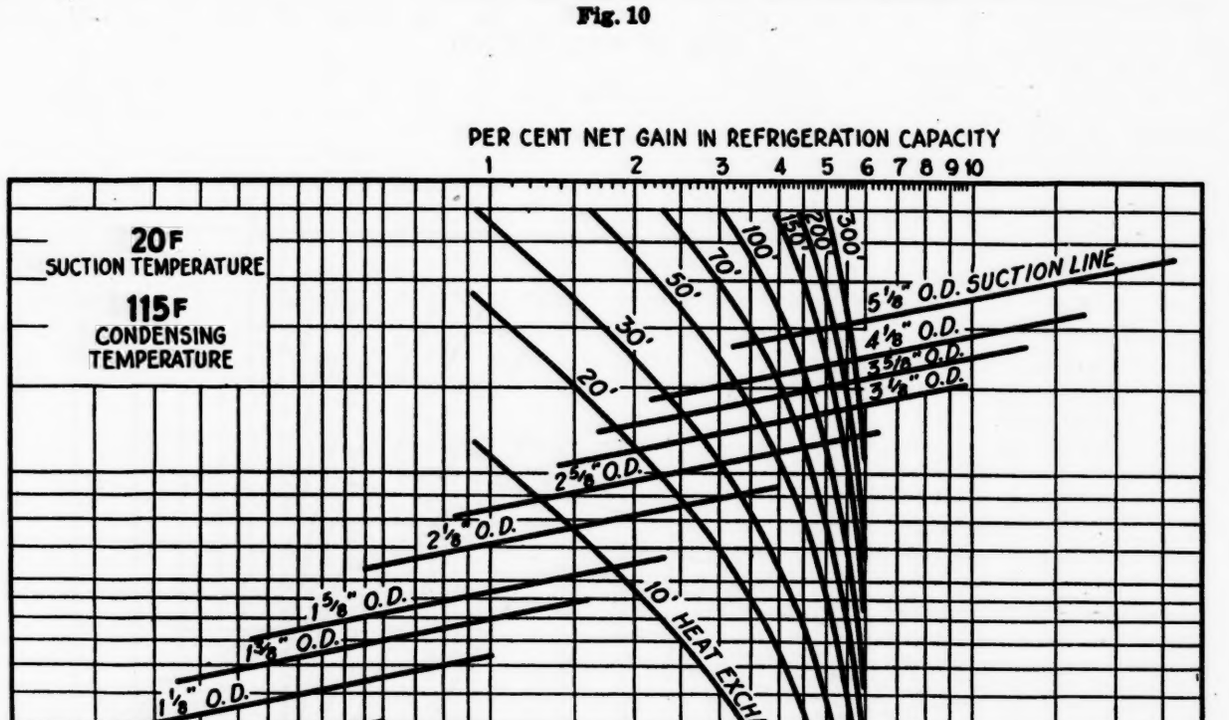

Fig. 11

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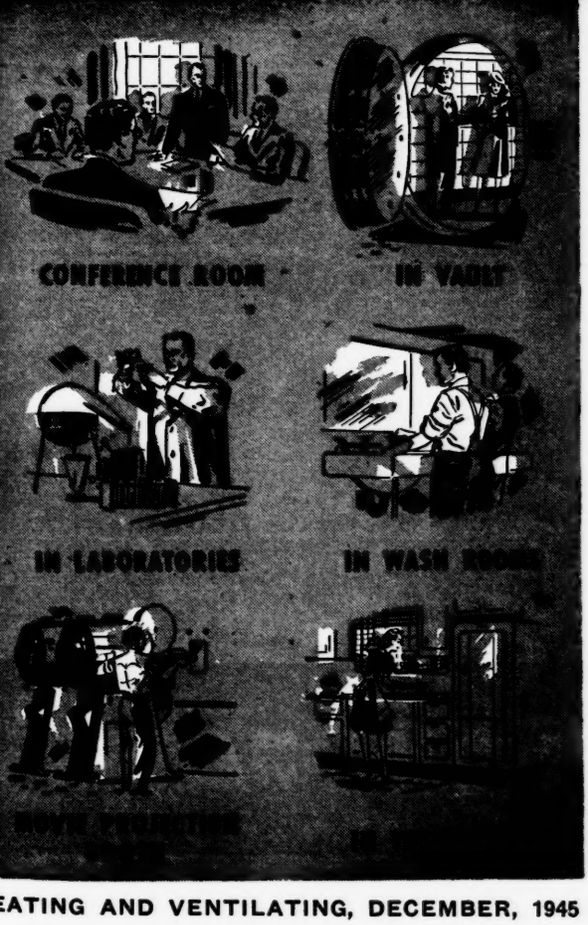
WHISPER INSTEAD OF A ROAR



Give stale air a quiet exit with Sturtevant's Super-Quiet REXVANE VENTILATING SET

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Nine sizes of Rexvane Ventilating Sets are now available, with rotors ranging from 6" to 24" in diameter, and capacities from 250 cfm to 6,000 cfm. Write for Bulletin No. 406, containing complete data . . . or let a local Sturtevant Field Engineer help you select the right equipment for your particular exhauster needs.

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Division of Westinghouse Electric
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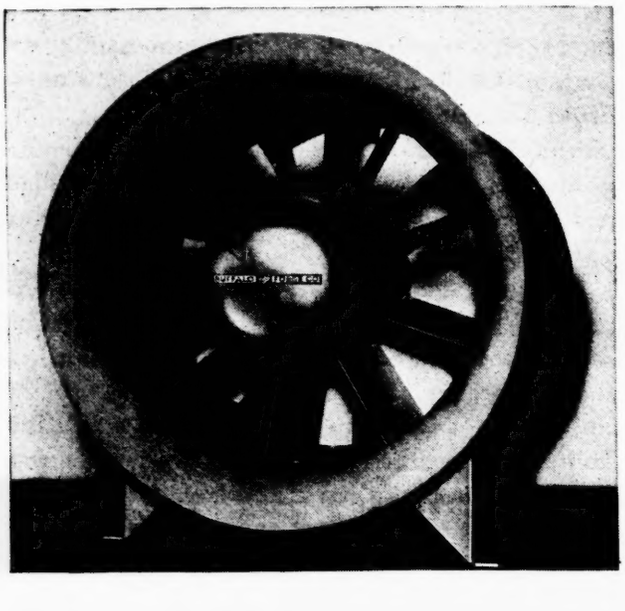
Sturtevant
Puts Air to Work

All "Axials" are NOT alike

All axial flow fans have certain advantages and disadvantages when compared to centrifugal fans on the same service.



For example—where a system has elbows or bad duct conditions near the fan inlet or outlet, a centrifugal fan will in most cases be a better selection. For handling dust-laden air, hot gases and corrosive fumes, centrifugals are generally preferable.

And, comparing Axials with Axials, there are some differences which are not at once apparent. In any propeller or axial flow type of wheel the air leaves the blades with a rotating, or screw motion. This is a characteristic of all propeller type fans and tends to increase when the fan is working against pressure. This swirling effect of the air leaving the fan means a drop in efficiency.

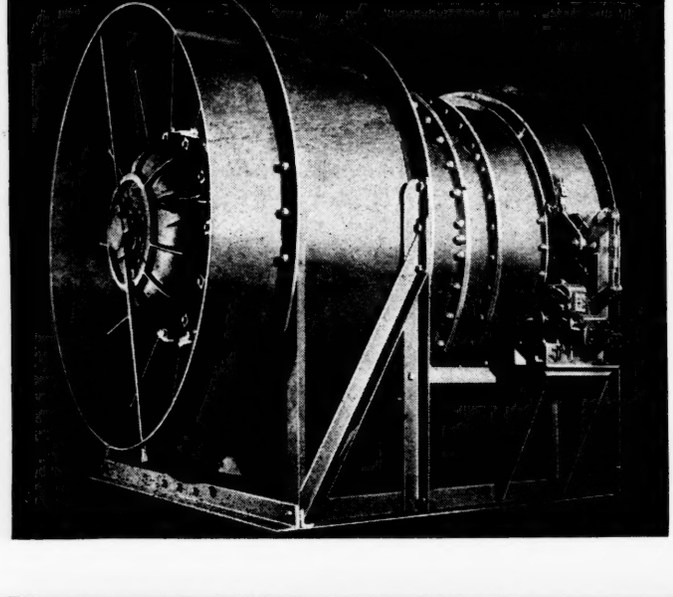
In Buffalo Axial Flow Fans a set of stationary curved vanes at the discharge side of the wheel correct this swirling motion of the air—deliver it in a "straight ahead" axial direction. Thus Buffalo Axial Flow Fans deliver full rated capacity in the system, and provide higher pressures than could be obtained at the same fan speed without vanes.

Users benefit by Buffalo's 67 years experience in designing and building fans of all types.

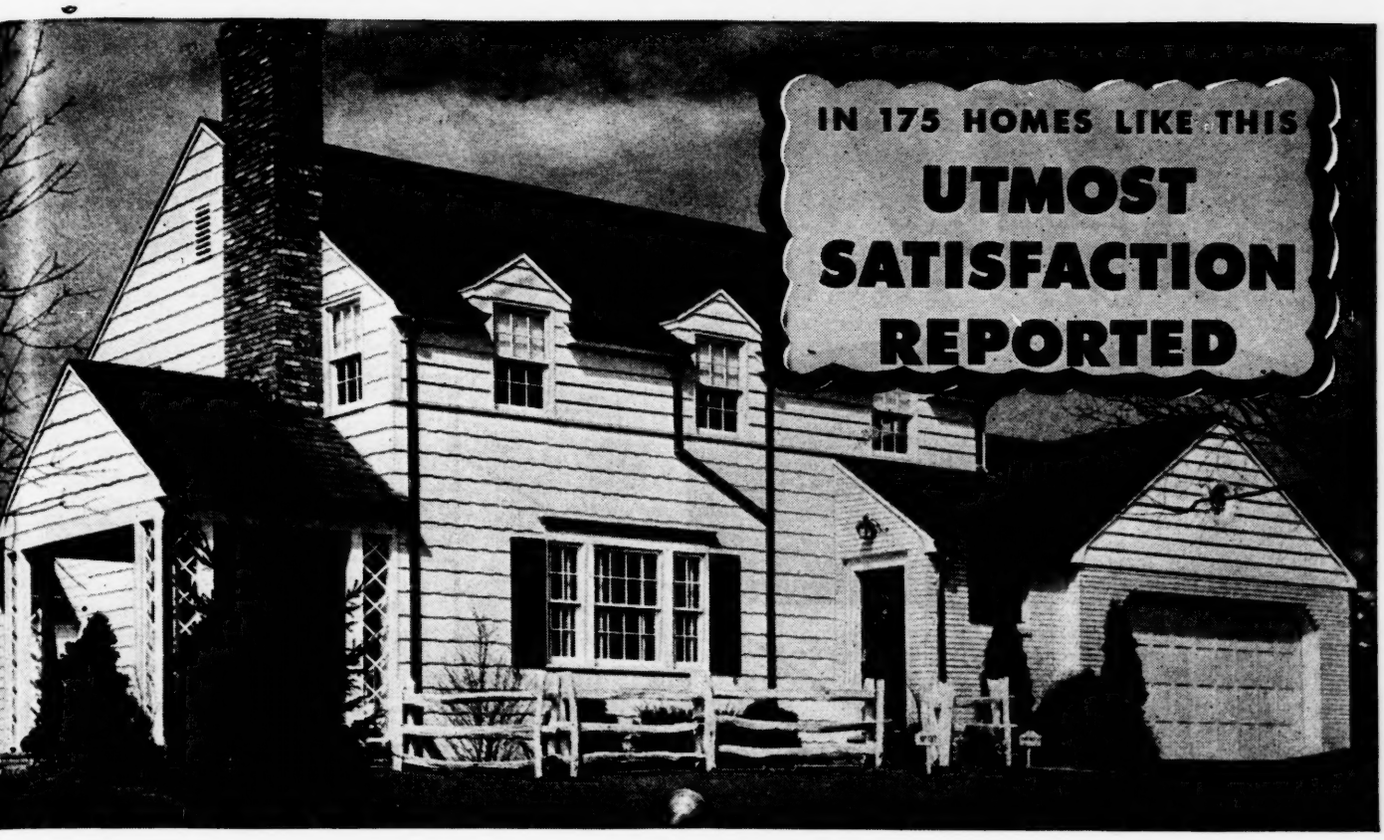
BUFFALO FORGE COMPANY

480 Broadway **Buffalo, N. Y.**

Canadian Blower & Forge Company, Ltd., Kitchener, Ont.



"Buffalo" **AXIAL FLOW FANS**



Year 'round hot water—a plus value!

Who, in this day of modern conveniences, can be content with anything less than a boundless supply of hot water. Every household task is made easier when piping hot water is always available... every little luxury of personal cleanliness can be enjoyed to the utmost. And remember—the new dish and clothes washers can't be operated on a mere trickle of hot water!

A B & G Hydro-Flo Heat System furnishes hot water for all household uses—24 hours a day, Winter, Summer, Fall and Spring—at so low a cost it can be used unsparingly.

What better recommendation of a heating system could you ask than the enthusiastic praise of its users? Williams-Harter Corporation, builders and developers at Port Washington, Long Island, N. Y., say this about B & G Hydro-Flo Heat (*Forced Hot Water*) Systems:

"... our engineers made a very careful analysis of the house heating problem, finally concluding it would be best that we standardize on the hot water, motor circulated distribution system.

"We then elected to use Bell & Gossett circulating pumps and the other items of your manufacture necessary to complete this system.

"One hundred and seventy-five homesteads are using this equipment now and *in every case the utmost of satisfaction has been reported!* Each home owner tells us of his heating comfort and economical operation—your equipment goes along so quietly, too.

"We therefore felt you would like to know about these results here—*the service-free benefit of this working equipment to any builder is of extreme value.* This compliment is well earned by yourselves."

B & G Hydro-Flo Heat is winning equally enthusiastic comment from owners of apartments, commercial and industrial buildings. It is the system which matches the heat supply to the weather—at all times keeping indoor temperature at a constant, comfortable degree. Send for literature.

HYDRO-FLO HEAT IDEAL FOR RADIANT PANEL HEATING
Successful Radiant Heating depends upon the use of comparatively large heating surfaces at low temperatures. With the simplest kind of equipment, a B & G Hydro-Flo Heat (Forced Hot Water) System accurately maintains the temperature of the circulating water at the proper degree.

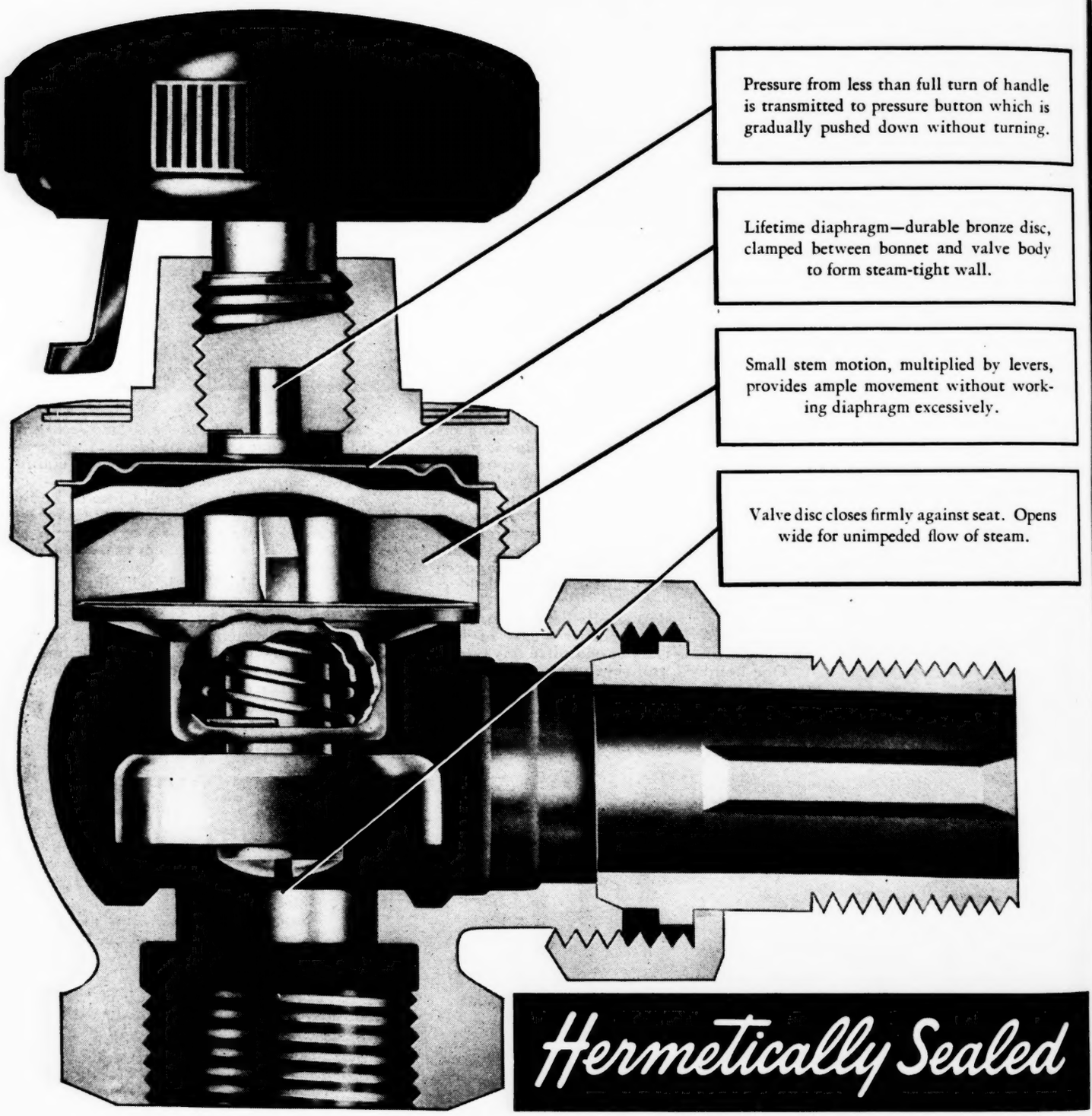
B & G Hydro-Flo Heat equipment can be installed on any hot water heating boiler.

BELL & GOSSETT CO.
Dept. H-4 MORTON GROVE, ILL.

Hydro-Flo HEAT

FORCED HOT WATER HEATING FOR RADIATOR, CONVECTOR, UNIT HEATER AND RADIANT PANEL SYSTEMS

AT LAST



Pressure from less than full turn of handle is transmitted to pressure button which is gradually pushed down without turning.

Lifetime diaphragm—durable bronze disc, clamped between bonnet and valve body to form steam-tight wall.

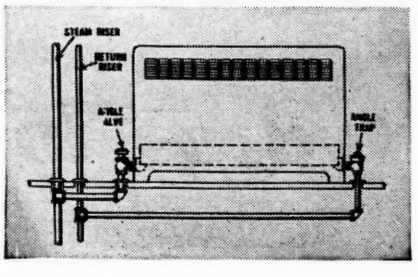
Small stem motion, multiplied by levers, provides ample movement without working diaphragm excessively.

Valve disc closes firmly against seat. Opens wide for unimpeded flow of steam.

Hermetically Sealed

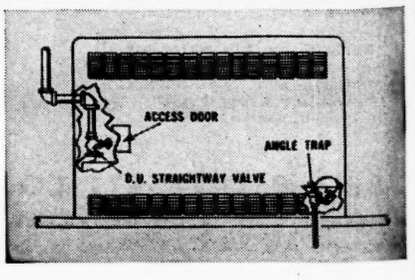
1.

Lifetime Angle Valve and B-1 Angle Trap used with Trane Convector-radiator where horizontal laterals are below the floor.



2.

Lifetime Double Union Straightway Valve and B-1 Angle Trap inside Convector-radiator cabinet. Downfeed steam riser.



A TRULY PACKLESS VALVE

WITH A LIFETIME* GUARANTEE

ERMANENTLY ELIMINATE STEAM LEAKAGE ND MAINTENANCE WORRIES . . .

PECIFY TRANE No. 44 LIFETIME VALVE

THIS TRANE VALVE will never need to be replaced. Install it and forget it. It is simple, rugged, everlasting, and it carries Trane's lifetime guarantee against stem leakage. It is especially adapted for service on Convector-radiators, and other heating equipment used on vapor, vacuum, two-pipe steam, and forced circulation hot water systems. Complete range of sizes and patterns.

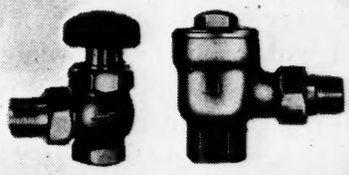
How is it different? A tough bronze diaphragm forms a hermetic seal between the stem and the valve body. It seals steam and water in, seals air out. A slight "oil can" effect moves the center of the disc while the edges remain firmly sealed to the body of the valve. And an ingenious lever device triples the effect of this movement, minimizing mechanical strain on the Lifetime Diaphragm.

No leaky packing or stuffing box. No bellows. The Trane Valve is truly packless; made to last a lifetime. It is sturdily built with heavy cast brass body and bonnet. Cool plastic handle with indicator disclosing valve setting. Valve discs are high temperature, non-swelling, non-shrinking, perma-type composition.

Be sure to specify Trane No. 44 Hermetic *Lifetime* Valve. For information, technical and installation details, send in your reservation at once for the new Trane Heating Specialties Bulletin DS-260, now on press. It will contain complete information on all Trane Steam Heating Specialties.

**If stem leakage occurs at any time in the normal life of any properly used Trane Lifetime Valve, a new Lifetime Diaphragm will be mailed to the heating contractor by the Trane Company without charge.*

ALWAYS TEAMED FOR LONG LIFE



NO. 44 LIFETIME VALVE **THERMOSTATIC TRAP**

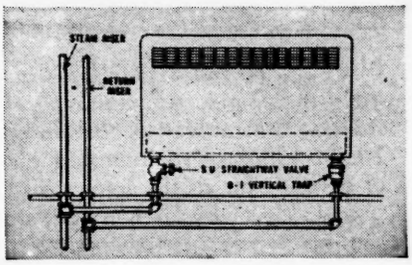
This trap improves the performance of vapor, vacuum, and steam heating equipment. It closes against steam, opens to pass air and condensation. The remarkable Trane bellows is supersensitive in performance, free-working and built for long life. Like the Lifetime Valve, you can install it and expect long years of excellent service with a minimum of attention.

Trane has a complete line of thermostatic traps up to pressures of 200 pounds. For ease of maintenance, to cut heating costs, always specify the Trane Lifetime Valve and Thermostatic Bellows Traps together.

FOR LONGER LIFE, EFFICIENT SERVICE

3.

Lifetime Single Union Straightway Valve and B-1 Vertical Trap. Horizontal laterals below floor. Globe and Corner Valves as well as Offset Traps are also available.



THE TRANE COMPANY

FIRST IN ENGINEERED CLIMATE

MANUFACTURING ENGINEERS OF HEATING, COOLING, AIR CONDITIONING AND AIR HANDLING EQUIPMENT

LA CROSSE, WISCONSIN

How to save equipment, power and fuel in heating and air conditioning systems you are now using, improving or designing

With Air Recovery Equipment, the system can serve a larger space or accommodate a heavier conditioning load

Since all ventilation is essentially the dilution of stale, odorous and contaminated air, fresh air for that purpose can be obtained by purifying already conditioned return air with Dorex *activated carbon* Air Recovery Equipment instead of drawing in and conditioning large quantities of outdoor air.

THE benefits of Air Recovery are available to either the large or small user of air conditioning. It may be used with profit in any winter or summer conditioned premises. With Air Recovery Equipment, the thermal and psychrometric values of used air, that ordinarily would be expelled, are conserved; outdoor air intake is cut and the load on heating, refrigerating and humidifying equipment reduced. For example:

Refrigerating equipment, fuel and power saved when Dorex is added to existing system

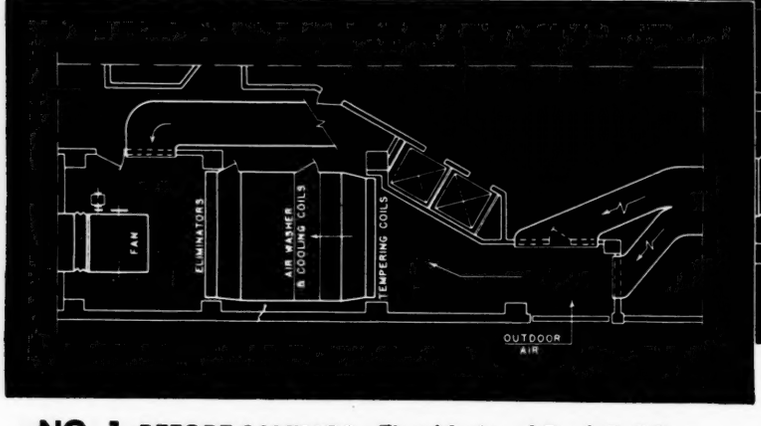
In the First National Bank Building, Detroit, internal air contamination had increased until it was necessary at times to bring in the maximum amount of outdoor air. The increased load which resulted put a strain on the heating facilities and overtaxed the cooling equipment to a point where additional refrigeration equipment seemed the only solution. However, the Dorex installation enabled the existing plant to handle the load and, according to Merle F. Bennett, Chief Engineer, the estimated savings of 100 tons of coal were passed before the end of the season. And, besides eliminating the need for additional refrigerating equipment, he estimates the annual saving in power to be about 36,000 KW hours.

Works like a gas mask

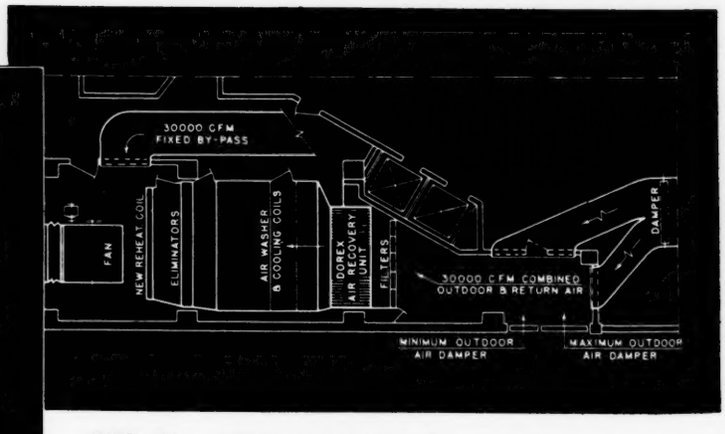
Nothing is added to the air. Vaporous and gaseous odors and impurities are removed, not disguised.

Activated carbon is the most powerful adsorption material known. It has been used for many years in industry for the recovery of chemicals in vaporous and gaseous form from air. Thousands of current applications demonstrate its ability to adsorb the airborne contaminants that make air stale and objectionable in commercial and industrial buildings. Impurities from occupants and their habits, from food and liquor in preparation and from lubricating oils, solvents, etc. in industrial processes—all can be extracted from air by adsorption.

How Dorex solved the problem can be seen in the before and after sketches of the actual installation



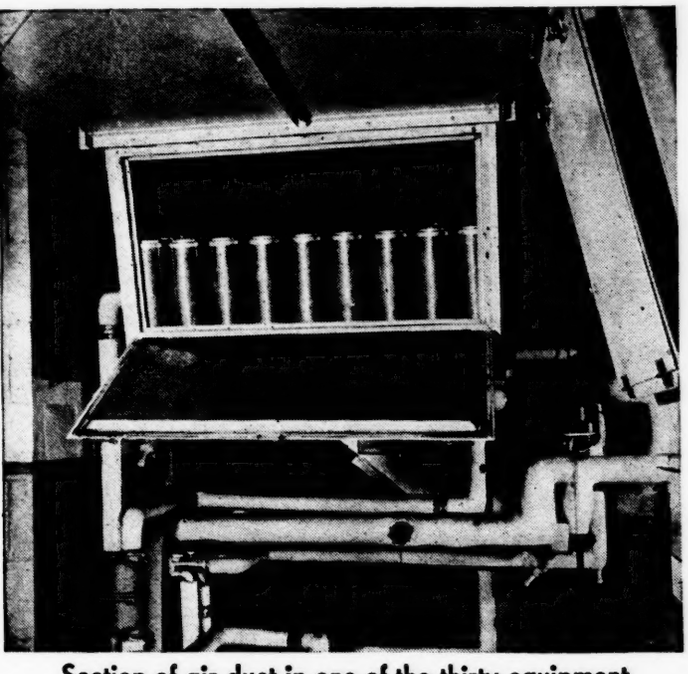
NO. 1 BEFORE SAVINGS: First National Bank Building equipment room. The air circulating system with a fan capacity of 60,000 CFM serves the general banking area, general office space and private offices.



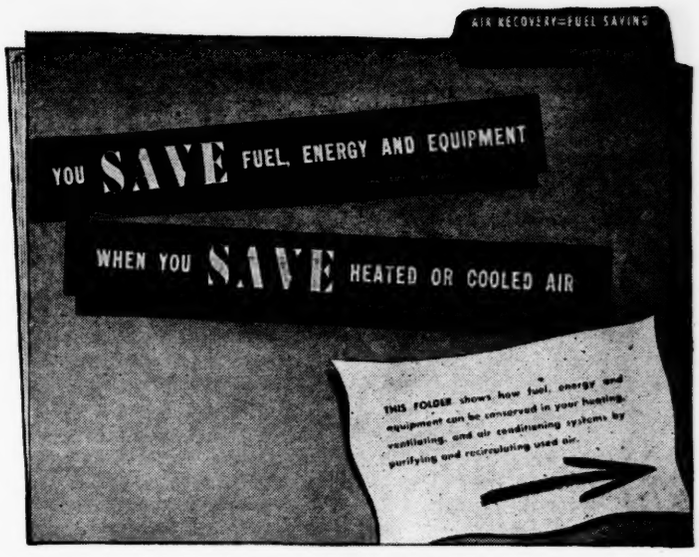
NO. 2 AFTER SAVINGS: Same equipment room after the Dorex Air Recovery Equipment was installed. The activated carbon canisters purify both 20,000 CFM of recirculated air and 10,000 CFM of outdoor air as the intake air is polluted at times by kitchen vent stacks.

275 tons refrigerating equipment, 90,000 gallons fuel oil saved when Dorex is designed in new system.

By installing the Dorex Air Recovery Equipment, the design engineers were able to cut the outdoor air intake for the Criminal Courts Building, New York City, by 102,680 CFM. If they didn't have the activated carbon units in the system to conserve the thermal values of that amount of air, which had already been heated or cooled, they would have needed about 275 tons of additional refrigerating equipment and approximately 10,000,000 BTU per hour additional radiation and boiler capacity under the design conditions existing for the building. Operating savings in fuel and energy, figured on an average heating season of 2,000 hours and a cooling season of 1,000 hours amount to approximately 90,000 gallons of oil and 122,600 KW hours of current per year!



Section of air duct in one of the thirty equipment rooms serving the courtrooms, showing assembly of Dorex activated carbon canisters.


AIR RECOVERY=FUEL SAVING
YOU SAVE FUEL, ENERGY AND EQUIPMENT
WHEN YOU SAVE HEATED OR COOLED AIR
THIS FOLDER shows how fuel, energy and equipment can be conserved in your heating, ventilating, and air conditioning systems by purifying and recirculating used air.

Free data folder

Send for FREE data folder giving the details of the installation of Dorex Air Recovery Equipment in the First National Bank Building, Detroit. In addition to showing how savings were effected by adding the equipment to an existing system, the folder contains helpful data on ventilation requirements, an installation and operating cost comparison chart that takes a typical example and demonstrates the savings realized when Air Recovery Equipment is designed into a new system, and a catalog section with information on Dorex and other W. B. Connor Engineering Corp. equipment. Perhaps you have already received a copy of the folder. We would appreciate your checking as our supply is limited.

Engineering help available

The W. B. Connor Engineering Corporation maintains a research laboratory, a staff of trained specialists, and district representatives in leading cities whose services are at the disposal of Consulting Engineers, Architects, Air Conditioning Equipment Distributors and Plant Engineers. Our staff can assist you in figuring out the economies and mechanics of air conditioning load reduction through Air Recovery, or help you apply the sound advantages of Air Purification to any manufacturing operation where contaminated air threatens product quality or production efficiency.

For full information and quotations on Dorex Equipment call the nearest District Representative or write Dept. D-7 112 East 32nd Street, New York 16, New York.

Proof of healthful, satisfactory air quality

After exhaustive tests by the government on all available methods, activated carbon was designated as the only one to be used to control unusual concentrations of airborne odors and impurities such as those occurring in railroad hospital cars. As a result, Dorex Air Recovery Equipment has been adopted as standard in Army Hospital Cars.

Other advantages of controlling air quality with Dorex Equipment.

- ***Better control of product quality***
- ***Improved working conditions***
- ***Greater customer satisfaction***
- ***Odor nuisance abatement***

The activated carbon in Dorex Air Recovery Equipment effectively removes air-borne acids, gaseous oxides and befouling odors from the air in recirculation or drawn in from outdoors. Thus it prevents the contamination of food and food ingredients, chemicals, drugs, etc., and protects a wide range of materials from the action of air entrained chemicals.

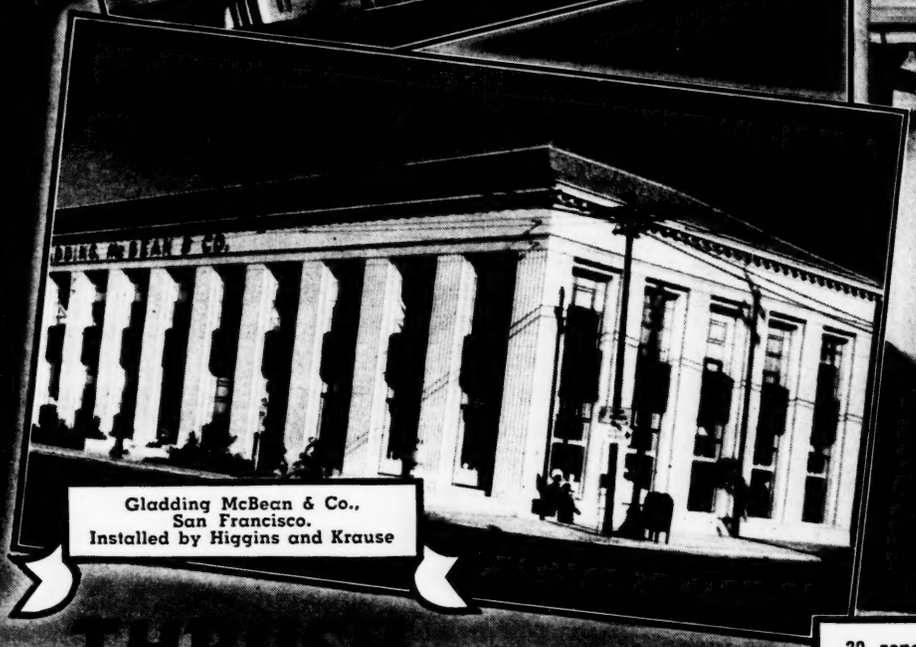
W. B. CONNOR ENGINEERING CORPORATION

AIR RECOVERY • AIR PURIFICATION • AIR DIFFUSION

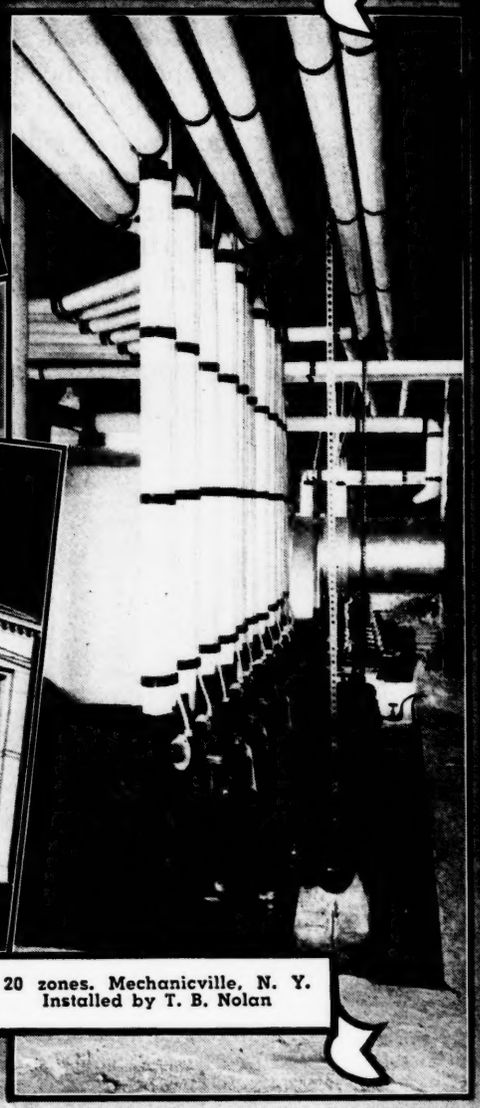
112 East 32nd Street — **New York 16, N. Y.**

THESE MODERN BUILDINGS ZONED BY THRUSH

Santa Fe Passenger Terminal,
San Francisco, California

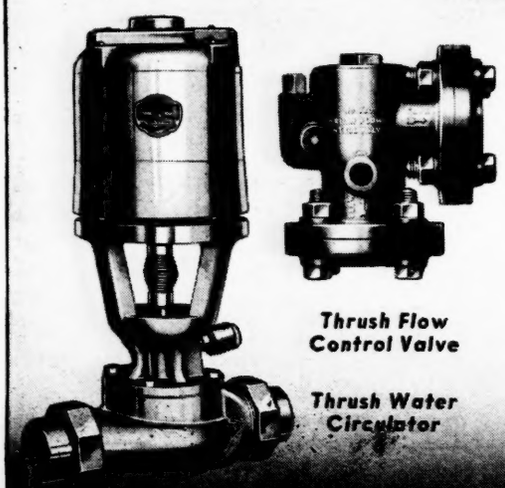


Gladding McBean & Co.,
San Francisco.
Installed by Higgins and Krause



20 zones. Mechanicville, N. Y.
Installed by T. B. Nolan

THRUSH ZONED *Hot Water Heat*



Thrush Flow Control Valve

Thrush Water Circulator

ALL over the nation Thrush Zone Control is saving heating dollars and conserving fuel. The illustrations show two typical office buildings heated by Thrush Zoned Forced Circulating Hot Water Heat, both of which have been giving satisfactory service for more than seven years, and an apartment house installation with twenty zones. The Dundalk Housing Development in Dundalk, Maryland, is using 68 zones to heat 8 groups of buildings. Schools, churches, hospitals, estates, industrial plants are all good prospects for you. They'll be glad to listen to a "money-saving, fuel-conserving" story these days. We'll help you make recommendations. See your Wholesaler today or write Department D-12.

There's always another one for us!

★ *Just when we think we've seen everything in special forged fittings another tricky requirement turns up . . . and probably always will. This time it's an order for seven-inch carbon-moly WeldELLS with integrally formed 3-inch outlets in their back walls.*

We have solved problems that are a lot tougher than this, but none exactly like it. Thus, like hundreds before it, it has contributed its share to the sum total of Taylor Forge "know-how" . . . is one more proof that we have honestly earned our reputation for doing things with hot metal no one else does.

THE unduplicated experience of Taylor Forge in the field of special forging has a vital bearing on your choice of standard welding fittings. It means there is nothing to be desired in welding fittings that is not within the scope of the methods and facilities that have grown out of this experience.

By applying these methods and facilities we have given WeldELLS features that are not combined in any other fittings. A good example of this is the uniform strength achieved through proper distribution of extra metal where stresses are higher. Another, is the extreme dimensional accuracy attained by special truing operations. Still another is the special process which forms the tangents, and there are many more.

This specialized Taylor Forge knowledge is responsible for the features listed opposite—is the reason why those who are best qualified to know will agree that

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends** —simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.

WeldELLS have everything

TAYLOR FORGE & PIPE WORKS, General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church Street • Philadelphia Office: Broad Street Station Bldg.

Here it is!

The NEW AIRCOBRAZE OUTFIT

for joining copper or brass pipe into "one-piece" lines...with threadless SILBRAZ* JOINTS

This is the outfit plumbers, heating and piping contractors are using to correctly install threadless, leakproof Silbraz fittings. Compact, convenient, the outfit includes everything needed (except the gases) for permanently and economically joining copper and brass pipe into "one-piece" lines . . . the modern Silbraz way.

All equipment supplied in the Aircobraze Outfit is of the same high quality and reliability for which Airco oxyacetylene apparatus has long been noted. Yet — the complete outfit is sold at a moderate price.

Airco also supplies the necessary gases (oxygen and acetylene). Airco Oxygen is produced under the most exacting conditions and is 99.5% pure in the cylinders, thus insuring maximum efficiency and economy. Airco Acetylene is the most economical fuel gas for brazing, welding and related applications. Both gases are available in standard, easy-to-handle cylinders.

The Aircobraze Outfit and gases can be obtained from conveniently located Airco distributing points throughout the nation. Stop in and ask about it . . . or fill in the coupon below and mail it today.

HV

AIR REDUCTION
60 East 42nd St.
New York 17, N. Y.

Please send me material checked:

—— Further information about the Aircobraze Outfit.

—— A free copy of the booklet: "How to Cash in on the Silver Alloy Ring."

NAME_____

FIRM_____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

AIR REDUCTION

General Offices: 60 EAST 42nd STREET, NEW YORK 17, N. Y.
In Texas: MAGNOLIA AIRCO GAS PRODUCTS CO. • General Offices: HOUSTON 1, TEXAS
Offices in all Principal Cities
Represented Internationally by Airco Export Corporation

AIRCO

They all REVOLVE

. . . the warmth-giving Sun . . . the life-producing Earth . . . the energizing Atom!

ike the sun, the earth, the atom, the Wing Unit Heater EVOLVES. It keeps the heated air in gentle motion, owly circulating a constant, uniform, EVEN tempera- re, transforming hot and cold spots into comfortable, nergizing, productive areas. The circulating heated air om the slowly revolving discharges reaches to farthermost orners, gets around and under obstructions, eliminates hot pots and cold spots.

Install Wing Revolving Unit Heaters now. Not only will ney heat your plant comfortably and evenly, bringing a ensation of fresh, live, invigorating warmth to workers. ut in the Summer, with the steam turned off and the fans n, they create a pleasant, cooling air motion over the entire rea.

Write for Bulletin HR

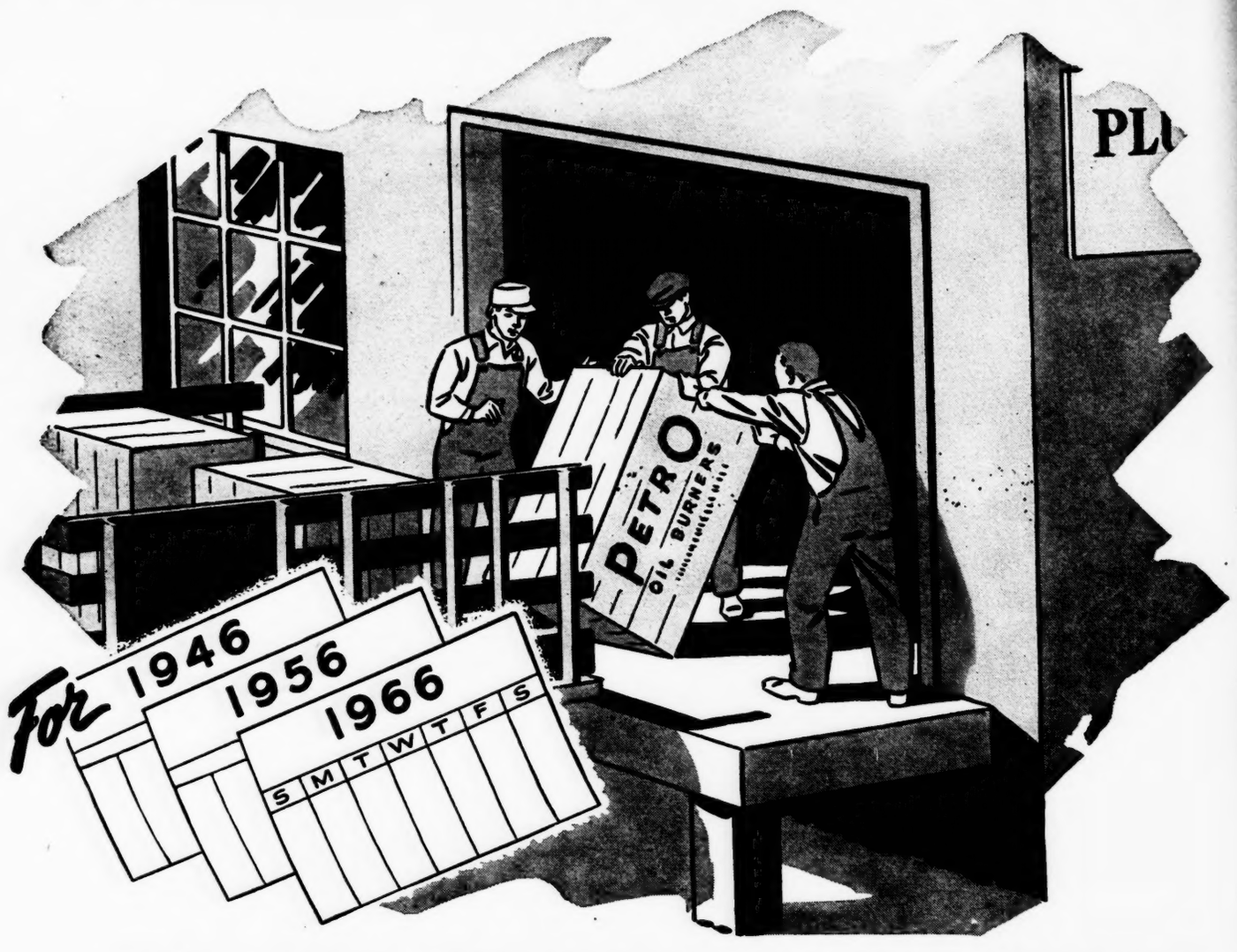
L. J. Wing Mfg. Co. 154 W. 14th St. · New York 11, N. Y.

Factories: Newark, N. J. and Montreal, Canada

Wing

REVOLVING UNIT HEATERS

URBINE BLOWERS · TURBINES · MOTOR DRIVEN BLOWERS · VENTILATING FANS · DUCT FANS · HEATING UNITS · SHIP VENTILATORS



...YOUR BEST ASSURANCE OF EVER-GROWING OIL BURNER SALES IS PETRO

ANYONE CAN SELL oil heating equipment today. But to maintain volume sales in the years after the first brisk demand has levelled off, it will mean getting there first with oil burners that have the most to offer!

The new Petro Oil Heating Equipment not only will have many *new* sales features to give you this selling advantage, but will be value-priced to meet the toughest competition! New improvements in design insure continued Petro popularity with burners well-known for their economical and dependable operation. An attractive . . . styled-for-eye-appeal line covers the complete capacity range for both "conversion" burners and "units".

And of particular value to you . . . every Petro Oil Heating System you install means a satisfied customer. It is your best assurance of volume sales in 1956 and 1966 as well as today! *Petro Oil Heating Equipment is distributed through heating wholesalers.*

Write for your nearest heating wholesaler today!

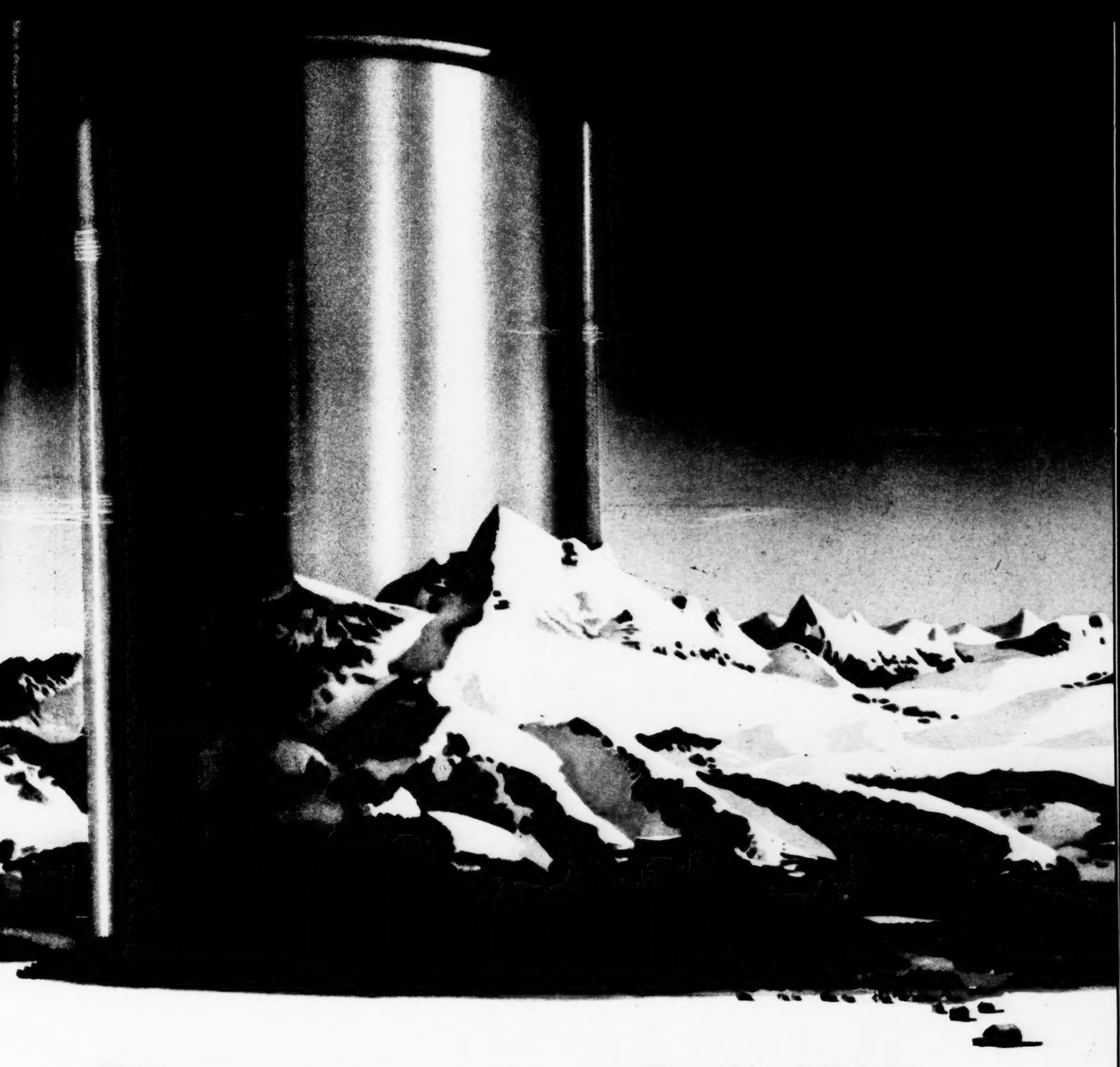
PETROLEUM HEAT AND POWER COMPANY • Stamford, Conn.

Petro Fuel Oil bulk plants, distributing terminals and facilities in: Mt. Vernon • Newark • New York
Baltimore • Stamford • Boston • Long Island • Washington • Providence • Philadelphia • Chicago

OHI

PETRO
REG. U. S. PAT. OFF.

MAKERS OF
GOOD OIL BURNING
EQUIPMENT SINCE 1903



Did you ever see a tin can **7** miles high?

Niagara Falls couldn't fill this can in 2 years

Imagine a can towering 7 miles into the stratosphere, with a base broad enough to cover downtown Pittsburgh—a container of such gigantic capacity that all the water roaring over Niagara Falls in 2 years couldn't fill it.

The billions of square feet of material required to build such a can represent the annual tin plate capacity of Weirton Steel Company, the largest independent producer of tin plate in the world.

This large demand for Weirton tin plate, like the extensive market for Weirton's many other products, is the natural result of Weirton Steel Company's rigid control of quality in all manufacturing operations.

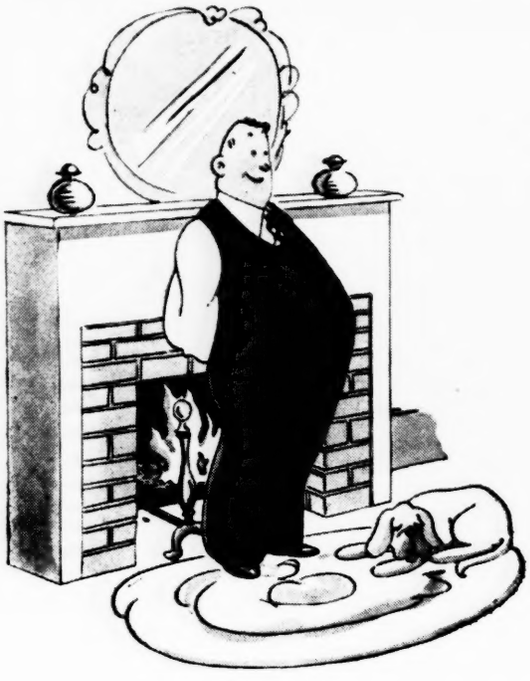
Weirton has the *facilities* for quality. Its management, with constant emphasis on advanced steel making practice, has been an international factor in progressive industrial thinking. And, its completely integrated steel mill is an outstanding example of what modern equipment can mean in maintaining strict product standards.

WEIRTON STEEL CO.

Weirton, West Virginia

Sales Offices in Principal Cities

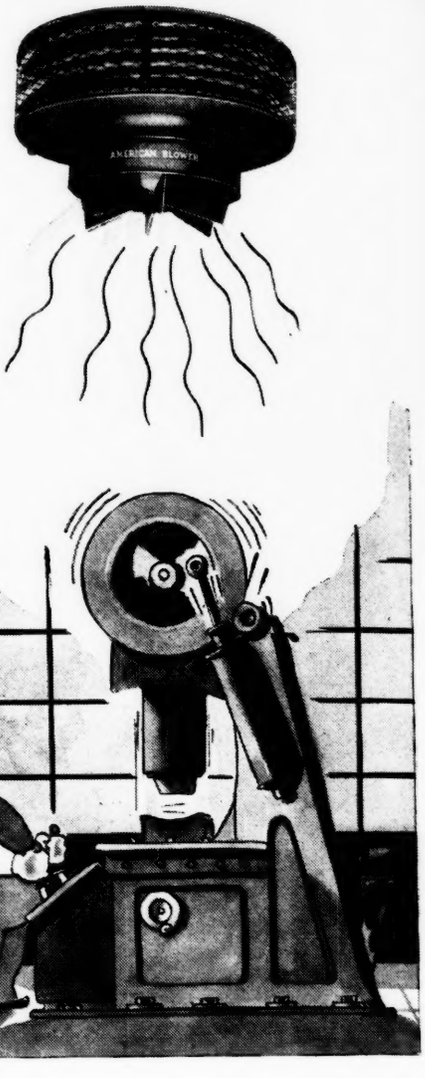
DIVISION OF NATIONAL STEEL CORPORATION



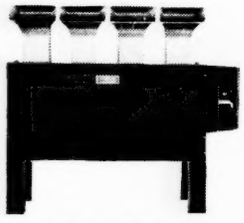
Say, why do you wait?

A heating contractor named Muir
Doesn't worry — he knows he's secure,
For he sells A-B-C
Unit Heaters — all three;
Of a prosperous future he's sure.

He sells them to plants by the score —
They're made for wall, ceiling or floor.
"When I get 'em," says he,
"In the right quantity,
I'll be able to sell a lot more.

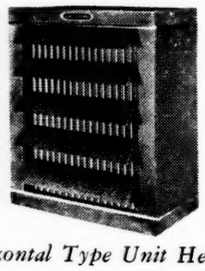


"But until the great day when I can
Sell heaters in quantities again,
I'll still do first rate.
Say, why do *you* wait
To come into the A-B-C clan?"



Blower Type Unit Heaters

Vertical Type Unit Heaters



Horizontal Type Unit Heaters

P.S.: Bear with us if you cannot get all the American Blower Unit Heaters you want quite as soon as you'd like to have them. They are coming through in ever increasing quantities.

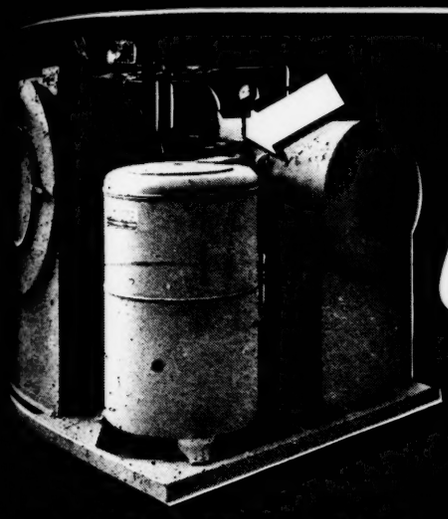
American Blower Unit Heaters are built in a complete range of capacities and sizes for wall, floor, or ceiling mountings.

AMERICAN BLOWER

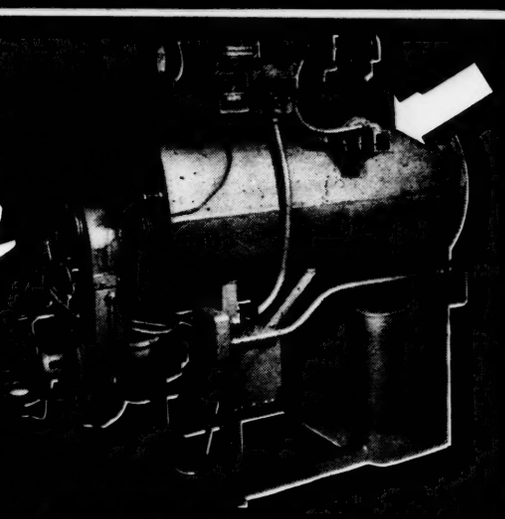
AMERICAN BLOWER CORPORATION, DETROIT, MICH.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.

Division of American Radiator & Standard Sanitary corporation

Airborne laundries



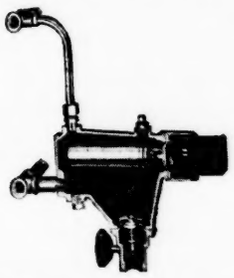
● Self contained washer, and extractor unit built by The Prosperity Company, Inc., Syracuse, N. Y., mounted for transporting on cargo plane. Arrow points to McDonnell "Built-in".



● Water heater for supplying hot water to washer. Water heater and oil burner are built into a complete unit requiring only a supply of water and gasoline or fuel oil for speedy operation.

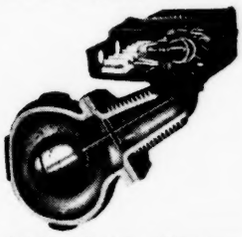
WHEN you looked at pictures from remote outposts of washing machines G.I.'s rigged up out of gasoline tanks and jeep parts, you began to realize that the American standard of cleanliness is something more than an idle boast.

Such pictures apparently convinced supply officers that this traditional cleanliness of the G.I. deserved encouraging. Hence these "airborne laundries" with water heaters produced by Orr & Sembower, Inc., that have winged their way to the four corners of the earth. They were compactly built to be transported in C-47 cargo planes to places inaccessible by boat or truck. But despite their small size they provide good laundry service for as many as 600 men.



McDonnell No. 67 Low Water Cut-off for boilers with steam pressure up to 15 lbs. It is basically the same as the McDonnell cut-offs built into the airborne laundries.

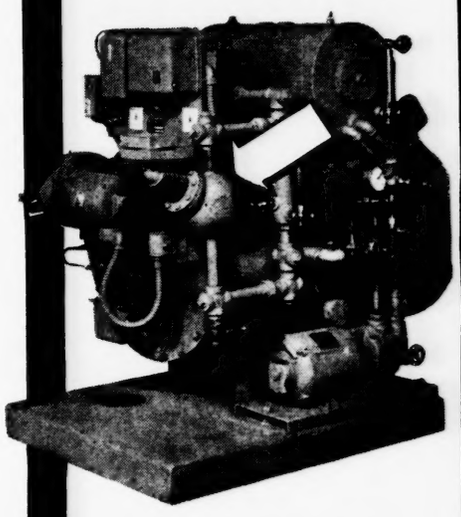
Two units, as illustrated above, comprise the laundry, and on each a McDonnell Built-in Type Low Water Cut-off protects the tank from low water damage. This application and the use of McDonnell No. 150 Low Water Cut-off on the Orr & Sembower "Powermaster" (opposite) were typical of the broad wartime uses of McDonnell Boiler Water Level Controls.



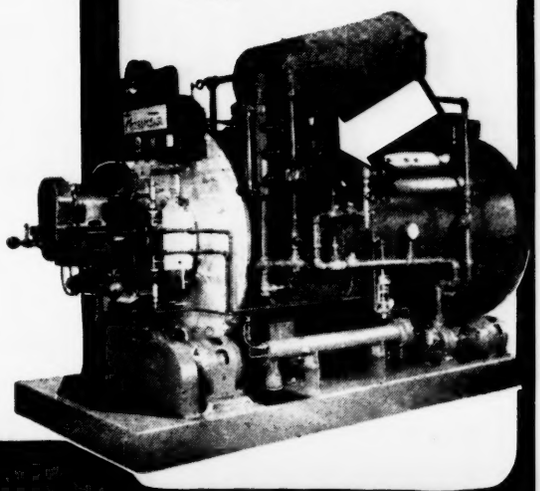
McDonnell No. 150 Low Water Cut-off, Alarm and Pump Control for high pressure boilers as used in the O & S "Powermaster" (opposite).

Orders like these had to *move.* That is why we were compelled to delay certain other orders—even some carrying high priority ratings—through and beyond V-J day. In building equipment we are still "Doing One Thing Well". But in shipping orders . . . well . . . that's why we are citing vital applications like this to show you just what we have been up against and still haven't been able to lick completely.

ALSO THE "POWERMASTER" BY O & S



● The "Powermaster"—oil-fired "packaged" power plant — is another O & S product that fulfilled vital wartime needs. It is made in capacities from 6 to 250 hp.; generates steam at 100 lbs. pressure from 60 deg. water in 18 minutes. The unit is furnished complete including the McDonnell No. 150 Low Water Cut-off. A 6 hp. plant is shown above; larger plant below.

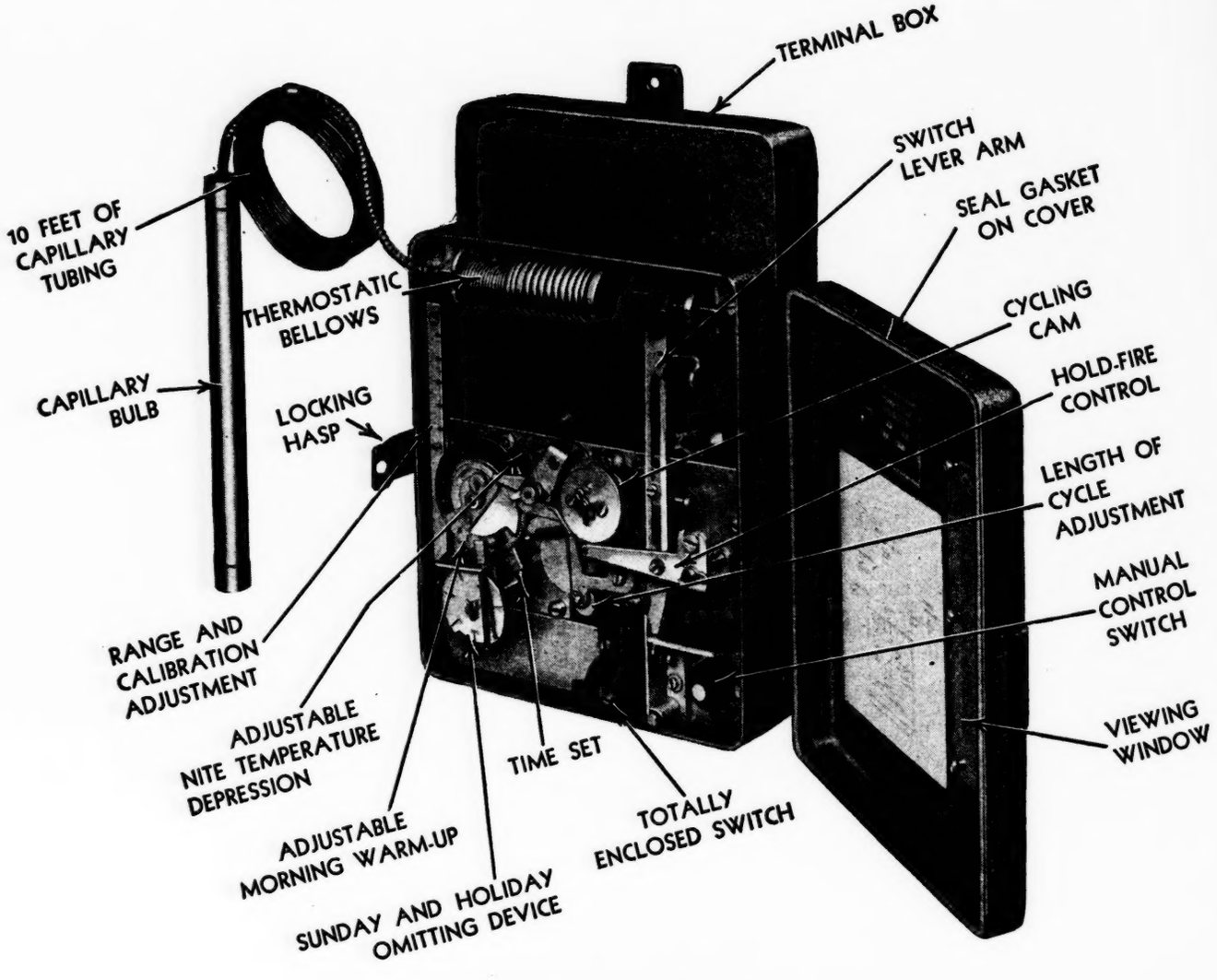


McDONNELL & MILLER, Inc., 1313 Wrigley Bldg., Chicago 11, Ill.

Doing One M&M SAFETY CONTROLS *Thing Well*

McDONNELL

MAXIMUM FUEL SAVINGS



WITH THE

BARBER-COLMAN Econostat

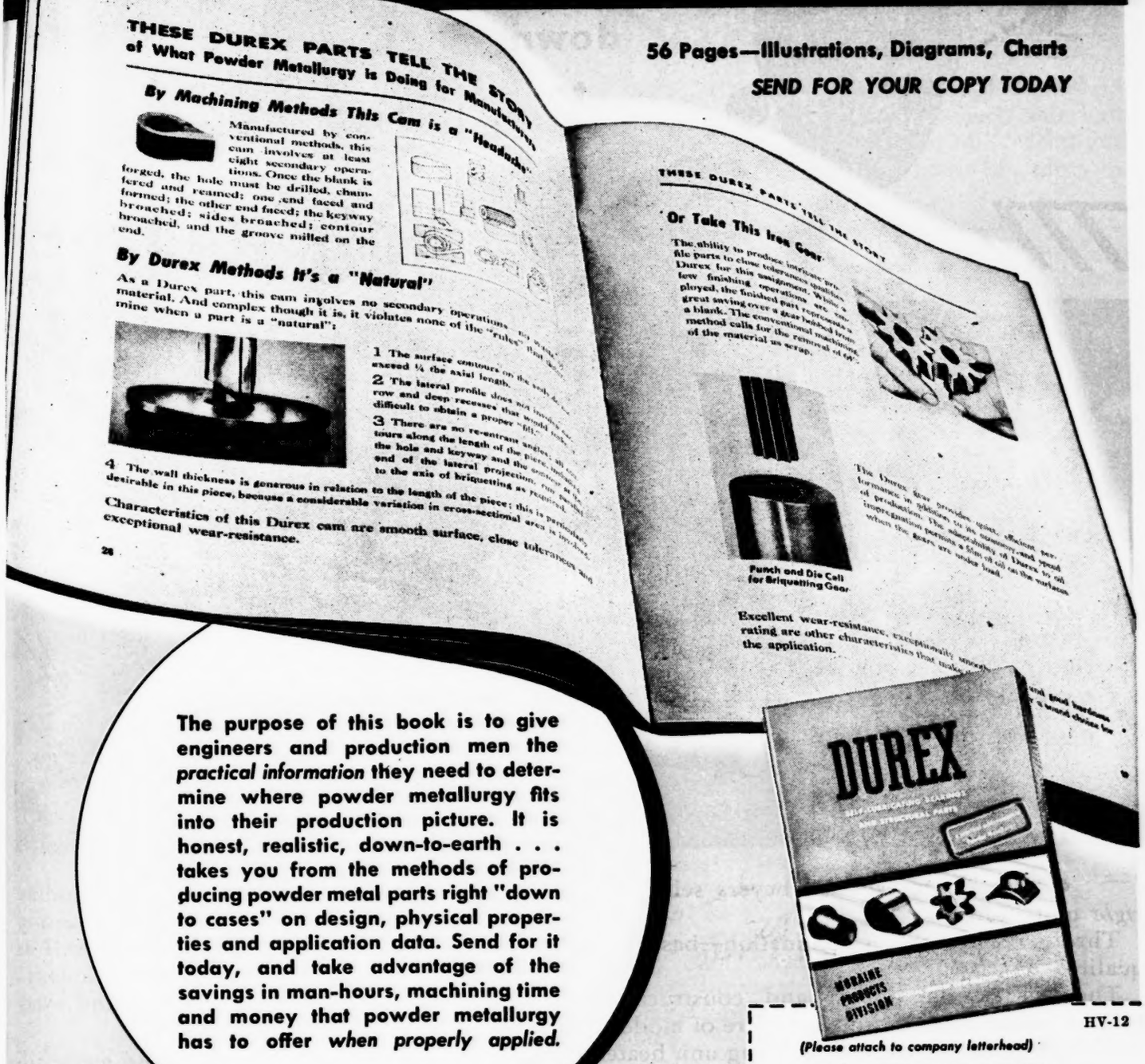
This efficient, durable, and highly flexible instrument is designed to control the operation of a motor driven valve (with central steam plant heat supply) or an oil or gas burner or stoker (where the building has its own heating system) so as to regulate the heating of a building *in accordance with changes in outdoor temperature* by supplying heat at intervals. It will avoid overheating and maintain more uniform temperature — thus achieving *maximum fuel savings.* Simple adjustments cover length of cycle, operating range, calibration, night temperature depression, and morning warm-up to suit individual building conditions. *A new circular gives complete details — get it from your Barber-Colman representative.*

BARBER-COLMAN COMPANY
1224 ROCK STREET • ROCKFORD, ILLINOIS

This book brings

POWDER METALLURGY

down to earth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of What Powder Metallurgy is Doing for Manufacturers
By Machining Methods This Cam is a "Headache"
By Durex Methods It's a "Natural"
THESE DUREX PARTS TELL THE STORY
Or Take This Iron Gear
Punch and Die Cell for Briquetting Gear

56 Pages—Illustrations, Diagrams, Charts

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The purpose of this book is to give engineers and production men the *practical information* they need to determine where powder metallurgy fits into their production picture. It is honest, realistic, down-to-earth . . . takes you from the methods of producing powder metal parts right "down to cases" on design, physical properties and application data. Send for it today, and take advantage of the savings in man-hours, machining time and money that powder metallurgy has to offer *when properly applied.*

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MORAINE PRODUCTS
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THE CHOICE OF QUALITY-WISE BUYERS always narrows down to

Modine Unit Heaters

● How do foresighted buyers select the *right* unit heater?

Through a process of elimination—based on quality!

They check on design and construction. Modines have every desirable feature of modern design—including many outstanding unit heater advancements that are exclusively Modine. Using the highest grade materials and proven processing techniques, Modine quality is *built in*—as only Modine's 29 years of *know how* can build it in.

These hard-headed buyers *double-check* on performance. They look at the *record* . . . Modine Unit Heaters have met the most exacting heating needs *satisfactorily.* During the war, as well as before the war! In thousands of installations . . . everywhere! That makes Modine far and away the *first choice.*

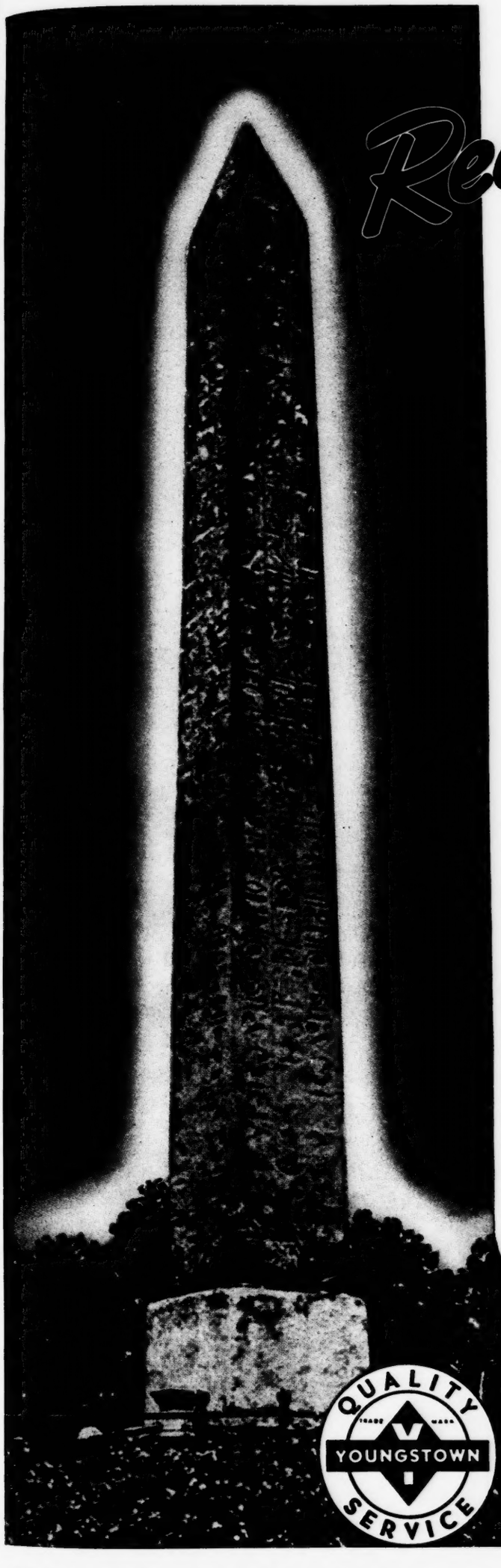
To you, Modine leadership means more advantages *and* more for your money with Modine Unit Heaters.

Look in your phone book for Modine representative's name—"Where to Buy It" section.

WRITE TODAY FOR MODINE UNIT HEATER BULLETINS

MODINE MANUFACTURING COMPANY • 1812 RACINE STREET, RACINE, WISCONSIN

Modine Unit Heaters



Record of a Past..

that knew no steel

ALMOST in the shadow of the world's tallest man-made structures stands this stone obelisk--"Cleopatra's Needle," in Central Park, New York. Its hieroglyphs boast of a glory that faded 3000 years ago.

If we deciphered these inscriptions, we would look in vain for the word Steel. Ancient Egypt hewed its monuments with tools of bronze. But bronze, then as now, was not plentiful enough to go far toward improving the lot of man.

What would our civilization be if we were deprived of steel? We might have monuments of stone, but no Radio City, no towering apartments or hotels, no modern hospitals, schools, or factories. For to sustain human life and human activity, we must have vast quantities of pure water and adequate sanitary facilities...from top floor to basement...provided only through miles of steel pipe. We must have quick, safe vertical transportation, possible only with steel elevators. We must have heating systems, production machines, equipment of a hundred kinds, available in the abundance which steel alone makes possible. In short, the difference between our civilization and that of the ancient world is expressed in terms of steel.

America stands on the threshold of a New Steel Age--with steels being given new characteristics and new virtues by metallurgists and chemists. Youngstown is ready to supply alloy steels as well as carbon steels--in sheets, tinplate, pipe, conduit, bars, wire, rods and shapes--to meet your needs in fabricating the products of peace.

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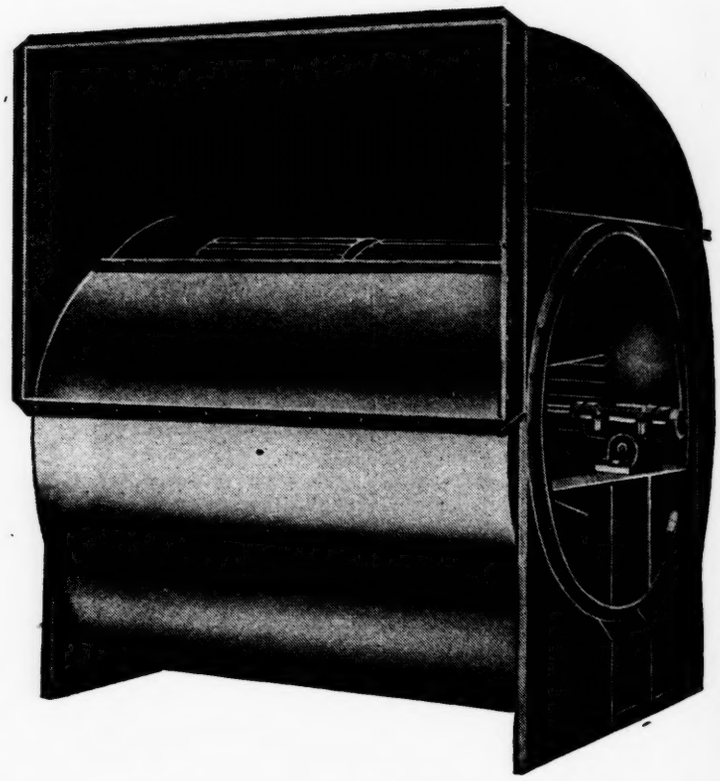

ALL THE NEWEST DEVELOPMENTS AND ADVANCEMENTS IN THE MANUFACTURING OF THE SQUIRREL CAGE TYPE OF BLOWER, ARE EMBODIED IN THIS LATEST MASSACHUSETTS SQUIRREL CAGE FAN. *Recognized for quality, design and precision workmanship by leading contractors, architects and engineers.*

Massachusetts *Squirrel Cage* Fans

HOUSING Above photograph shows double inlet, double width, non-convertible type, built-up housings. Rigidly reinforced by supporting angles. Easily dismounted. Smaller size fans, with wheels 36″ diameter and less, have convertible type housings.

WHEEL Correct design and precision workmanship result in low speed and quiet operation. All blades formed in dies—each blade machine riveted to back plate and rim. Rigid construction of solid back plate design permits entrance of air to wheel without obstruction. The hub has a semi-steel casting, conical in shape.

BEARINGS Standard equipment consists of grease lubricated double interlock pillow block roller bearings. The inner unit contains a cast iron housing fitted with special long inner race duplex Timken tapered roller bearing. Babitted type ring oil sleeve bearings also available as optional equipment.

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The BISHOP & BABCOCK *Mfg. Co.*

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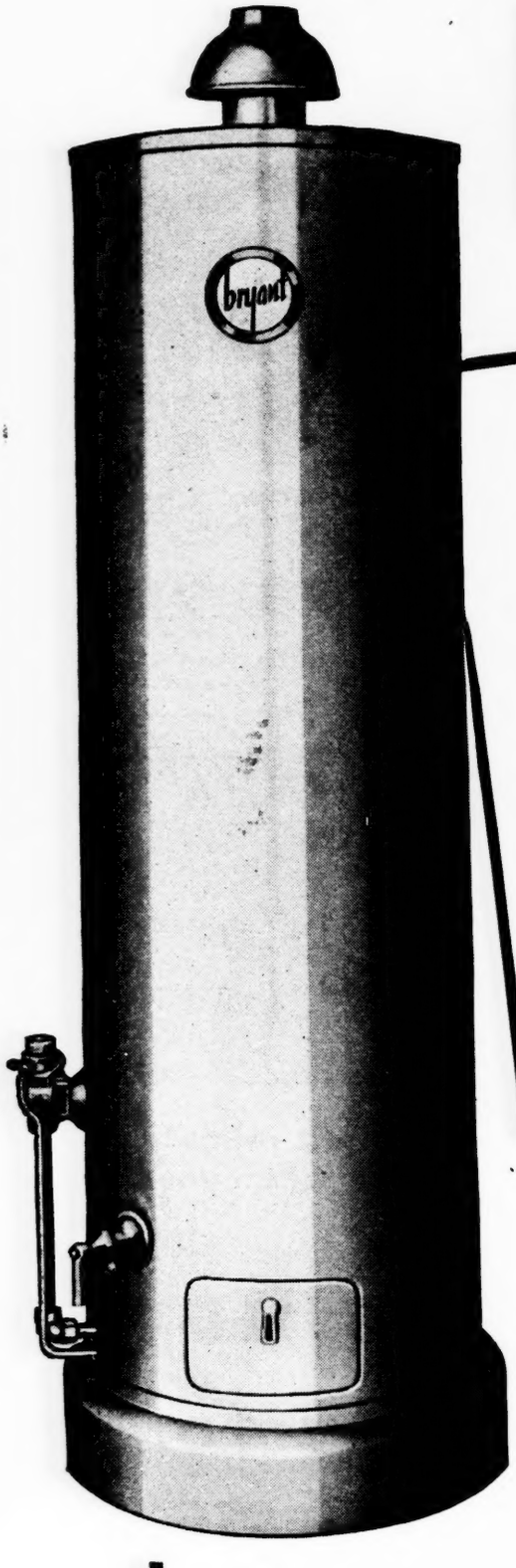
Our electrolytic refinery tanks producing copper for your tubing

SEAMLESS COPPER TUBING

FROM REFINERY TO PACKAGED PRODUCT— ALL IN THE SAME PLANT

LEWIN-MATHES

LEWIN-MATHES COMPANY · · SAINT LOUIS, MISSOURI



NEW!

Automatic Storage Water Heaters added to the Bryant Heater line

No doubt, it has come your way, too . . . that simple request so difficult to fulfill. "Give me a gas water heater as good as my Bryant home heating equipment," said the satisfied customer, "and you've made another sale!"

Certainly, that is a problem. But, not for much longer! Soon, you can supply water heating as well as home heating equipment bearing the famous Bryant name plate. Soon, the first Bryant Automatic Storage Water Heaters will begin moving off the production lines. And that means an extra sale of one of these modern models for you in almost every home where you sell Bryant automatic gas heating.

Consider the selling features of Bryant Water Heaters, too. They are completely automatic . . . super-insulated . . . flat-based for clean-around ease . . . give faster and cheaper heat transfer by passage of flue gases through a baffled tube centered in the water column . . . made in standard, de luxe streamline and table-top styles.

Americans know and prefer the home heating truly engineered to "let the pup be furnace man." Americans will welcome the same trouble-free service on their hot water heating job . . . *as well as the man who sells Bryant Automatic Storage Water Heaters!*

Bryant Heater Company, 17825 St. Clair Ave., Cleveland 10, O.
One of the Dresser Industries

bryant
GAS
HEATING

LET THE PUP BE FURNACE MAN

O.K. of a Great Critic...

A WHOLE PLANTFUL OF THEM WHO BUILD MOTORS TO SATISFY EXACTING BUYERS!

Other plants may turn out *more* motors than the Star Plant. But you'll find no *better* motors . . . for when you see the Star Trademark you see the "O.K." on the efforts of hundreds of meticulous craftsmen working to critical standards.

Among them are the men who own the company. For Star's owners are born motor men, and the place to find them is out in the plant or around a drawing board, helping to make Star Motors as good as they can be.

Everybody at Star is exacting about quality . . . in design, materials, workmanship. There's a craftsman's spirit everywhere that words can't cover. But motor buyers who visit us always comment on it. And exacting motor users recognize that Star does things a bit better by specifying Star where a motor must be better than "good enough".

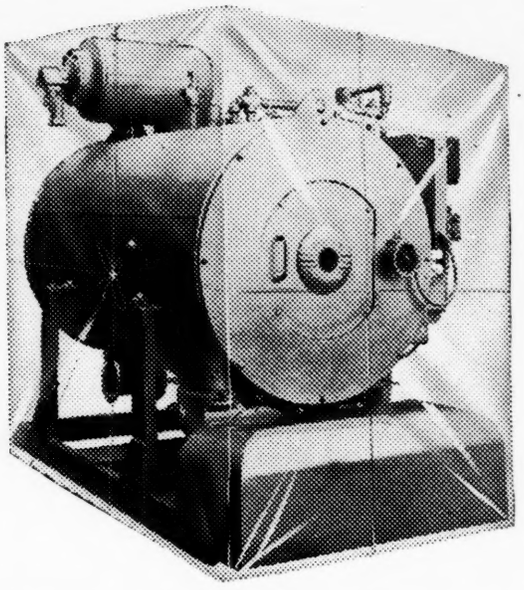
WRITE FOR 8-PAGE DIGEST. It outlines Star Motors (⅛ to 200 HP) and Generators (to 150 KW) . . . names hard-to-satisfy buyers who are long-time customers . . . tells how Star becomes the "Motor Department" for customers. Star Electric Motor Co., 226 Bloomfield Ave., Bloomfield, New Jersey.

STAR MOTORS

POWER PACKAGED AS YOU NEED IT

PACKAGED STEAM FOR INDUSTRY . . .

• A Huge Market Awaits Men with the Vision to Sell It . . . NOW!



After every war, peace brings great opportunity to men who recognize that opportunity and take advantage of it. The fleeting moment when important decisions are made finds them ready with that one priceless element of all success—VISION.

★ INDUSTRIAL OIL-FIRED BOILER EQUIPMENT—AMERICA NEEDS IT!

It is here . . . now . . . all around us: history's biggest market for modern, *ready-to-install* industrial boilers. Old, worn-out heating plants *must* be replaced—and quickly—if reconversion is to keep pace with demand. Old, cumbersome apparatus is out! Steam heating and processing plants want packaged units: boiler and burner engineered to work together.

YORK 4h HEAT

★ FACTORY-BUILT UNITARY EQUIPMENT—YORK-SHIPLEY HAS IT!

We are ready—with Industrial Oil-Burning Boiler Units—low and high pressure (15# to 125#)—5 h.p. up to 100 h.p.—very soon up to 200 h.p. and larger capacity. Factory-built, ready to operate, now moving off our production lines. This is equipment we have designed, tested, and operated the last two years . . . equipment we are now manufacturing in volume.

★ BACKED BY THIS LIVE-WIRE ORGANIZATION—YOU CAN SELL IT!

Our Industrial Division is anxious to contact those who are in a position to sell this equipment to the consumer. We believe it will be a highly profitable business for individuals and organizations, old and new. We are prepared to back you to the limit, with every consideration and all the co-operation you need, in every way.

INDUSTRIAL DIVISION

YORK-SHIPLEY *INCORPORATED*

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• *Inquiries regarding franchises are invited by personal letter, telephone, or telegraph.*

OR HOW KOOLSHADE* SUN SCREEN CUTS THE SOLAR LOAD ON WINDOW AREAS AS MUCH AS 90%!

Yet Provides Glareless Light and Ample Ventilation!

Hundreds of KOOLSHADE installations during the past seven years—in buildings utilizing all types of cooling systems—have proved the findings of the Pittsburgh Testing Laboratories conservative. In case after case, KOOLSHADE Sun Screen has reduced Solar Load through glass as much as 90%! The result has been appreciable savings in both original equipment and operating costs.

KOOLSHADE is the *only* form of sun insulation that stops direct sun rays without impairing vision or ventilation. Requires no adjustment . . . installed like ordinary insect screen. Will not rot, rust or rattle . . . demands no maintenance.

Because KOOLSHADE is entirely automatic in operation, it is a factor you can depend on. It reduces both original equipment and operating costs . . . minimizes complaints. Send in the coupon below for details.

*Trade mark . . . Property of the Ingersoll Steel Division, Borg-Warner Corp.

TABULAR DATA FROM PITTSBURGH TESTING LABORATORY

Solar Radiation Transmitted Through Windows Equipped with KOOLSHADE Sun Screen

Compared with Intensity of Solar Radiation Incident to Vertical Surface. **For 40 deg. Latitude, on July 21st** All figures given represent B.t.u. per sq. ft. per hour.

Sun Time AM	SOLAR RADIATION	NE ←	EAST ←	SE ←	SOUTH ↔	SW →	WEST →	NW →	Sun Time PM
6:00	Intensity Incident to Vertical Surface (1)	72	80	40		40	80	72	6:00
	Transmitted thru Window with KOOLSHADE (2)	33	38.5	13		13	38.5	33	
7:00	Intensity Incident to Vertical Surface	143	180	112		112	180	143	5:00
	Transmitted thru Window with KOOLSHADE	38.5	60.5	22		22	60.5	38.5	
8:00	Intensity Incident to Vertical Surface	143	211	155	8	155	211	143	4:00
	Transmitted thru Window with KOOLSHADE	17	42.5	20.5	0	20.5	42.5	17	
9:00	Intensity Incident to Vertical Surface	104	192	168	46	168	192	104	3:00
	Transmitted thru Window with KOOLSHADE	8	22	17	2	17	22	8	
10:00	Intensity Incident to Vertical Surface	46	143	156	77	156	143	46	2:00
	Transmitted thru Window with KOOLSHADE	1.5	11.5	13	4	13	11.5	1.5	
11:00	Intensity Incident to Vertical Surface		75	121	95	121	75		1:00
	Transmitted thru Window with KOOLSHADE		3.5	8.5	5.5	8.5	3.5		
12:00	Intensity Incident to Vertical Surface			73	103	73			12:00
	Transmitted thru Window with KOOLSHADE			3.5	6	3.5			

(1) Data from the A.S.H.V.E. Guide 1940.
(2) Figures represent Solar Heat Gain in EXCESS of heat gain by conduction through window glass.

Ingersoll
KOOLSHADE*
"It's Cooler in the Shade" *Sun Screen*

Ingersoll Steel Division
Borg-Warner Corp., Dept. C12
310 South Michigan Ave., Chicago 4, Ill.

Send us samples of KOOLSHADE Sun Screen and Test Solar Load Data.

Name.....

Company.....

Address.....

City.....**State**.....

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HELP BROADEN YOUR HEATER MARKET

Space heaters and furnaces equipped with "DL" Float Valves substantially broaden your heating market.—

Because there are so many places where these heaters and furnaces can be sold, either as replacement units or for new construction.

Hundreds of thousands of small homes building or built, stores, garages, gasoline stations, offices, small churches, need modern heat.

Ranges and water heaters often may be sold at the same time.

"DL" Float Valves provide one of the important essentials to a good heater—years of satisfactory, trouble free comfort. They're simple, easy to service on the rare occasions when they need it. They compensate automatically for fuel viscosity variation due to temperature change.

They're good valves—good products have them.

DETROIT LUBRICATOR COMPANY *General Offices:* 5900 TRUMBULL AVENUE DETROIT 8, MICHIGAN

Division of AMERICAN RADIATOR & Standard Sanitary CORPORATION

Canadian Representatives— RAILWAY AND ENGINEERING SPECIALTIES LIMITED, MONTREAL, TORONTO, WINNIPEG

"DL" Heating and Refrigeration Controls • Engine Safety Controls • Safety Float Valves and Oil Burner Accessories • "Detroit" Expansion Valves and Refrigeration Accessories • Stationary and Locomotive Lubricators

-purpose fan

That's the name for the Johnson belt-driven propeller fan shown above. It's big and its lusty . . . it has an appetite for work and no job is too tough to handle. ★ Displacing air at a rate of 4,500 to 25,000 cubic feet per minute (depending on size) it is capable of giving proper ventilation to small or large residences, offices, estaurants, factories, class rooms, garages, warehouses or any of a hundred different places. ★ The new 1946 model is now ready for delivery . . . sizes range from 24 inches to 54 inches. Order today . . . and save delay.

John an & Blower Corp.

1319 W Lake Street *Chicago,* Illinois

In plant and office it's JANITROL for gas heat!

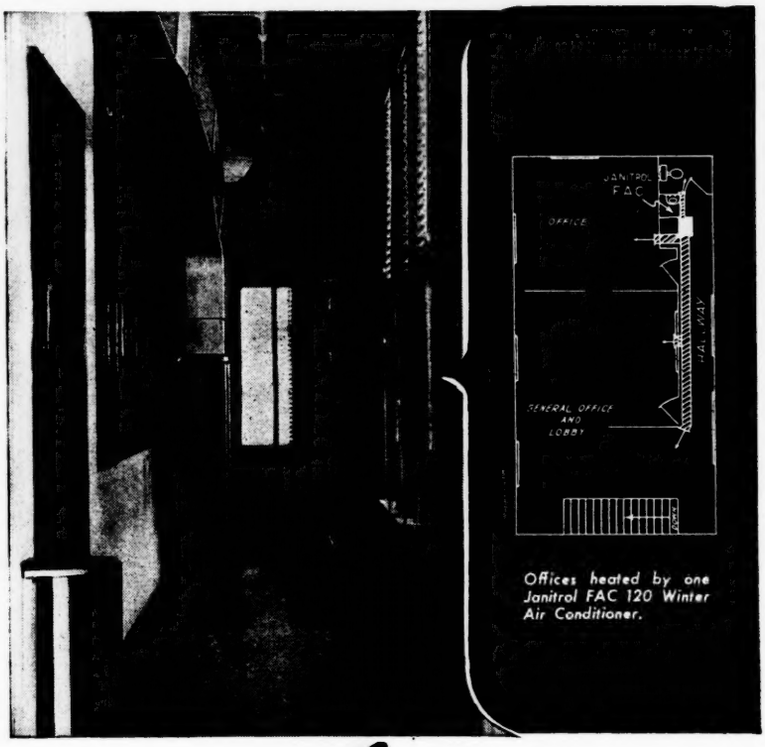
Plant heated by four Janitrol UAS 175 Unit Heaters, plus one UAS 65 for the three rear rooms.

RESULTS AT ROSS MFG.:

★Trouble-Free Service!

★Clean, Healthful Warmth!

★No Need For Services of Janitor!



Offices heated by one Janitrol FAC 120 Winter Air Conditioner.

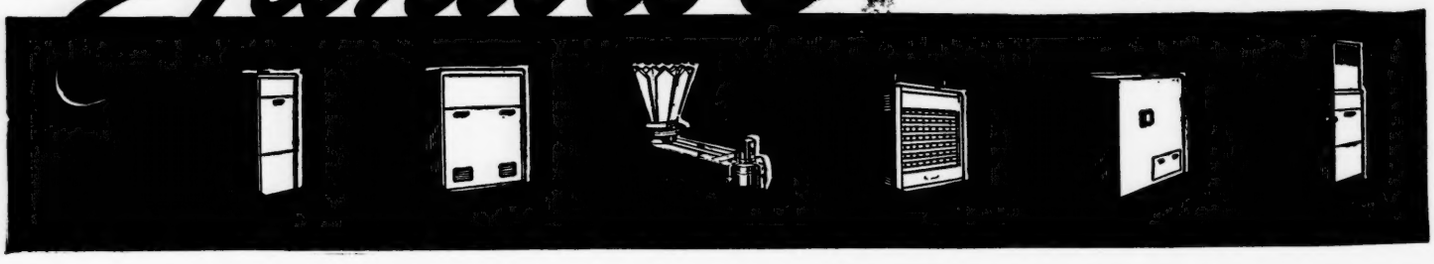
"Our six Janitrol Gas Units have rendered excellent trouble-free heating service since they were installed"—says Ross Manufacturing Company of Cleveland.

In the large machine shop shown above, 4 Janitrol Unit Heaters provide uniform low-cost warmth to the satisfaction of both the management and the workers. Several small rooms behind the machine shop are economically heated by another Janitrol Unit Heater.

In the offices, one Janitrol Winter Air Conditioner fits compactly into a narrow hallway, delivering heat by means of ductwork into four separate areas. All Janitrol units operate without services of a janitor . . . there's no fuel to store or handle. Units operate automatically . . . require practically no attention or maintenance work.

For further information on the complete line of Janitrol Gas-Fired heating equipment now becoming increasingly available, write Surface Combustion Corporation, Toledo 1, Ohio.

Janitrol GAS-FIRED HEATING EQUIPMENT



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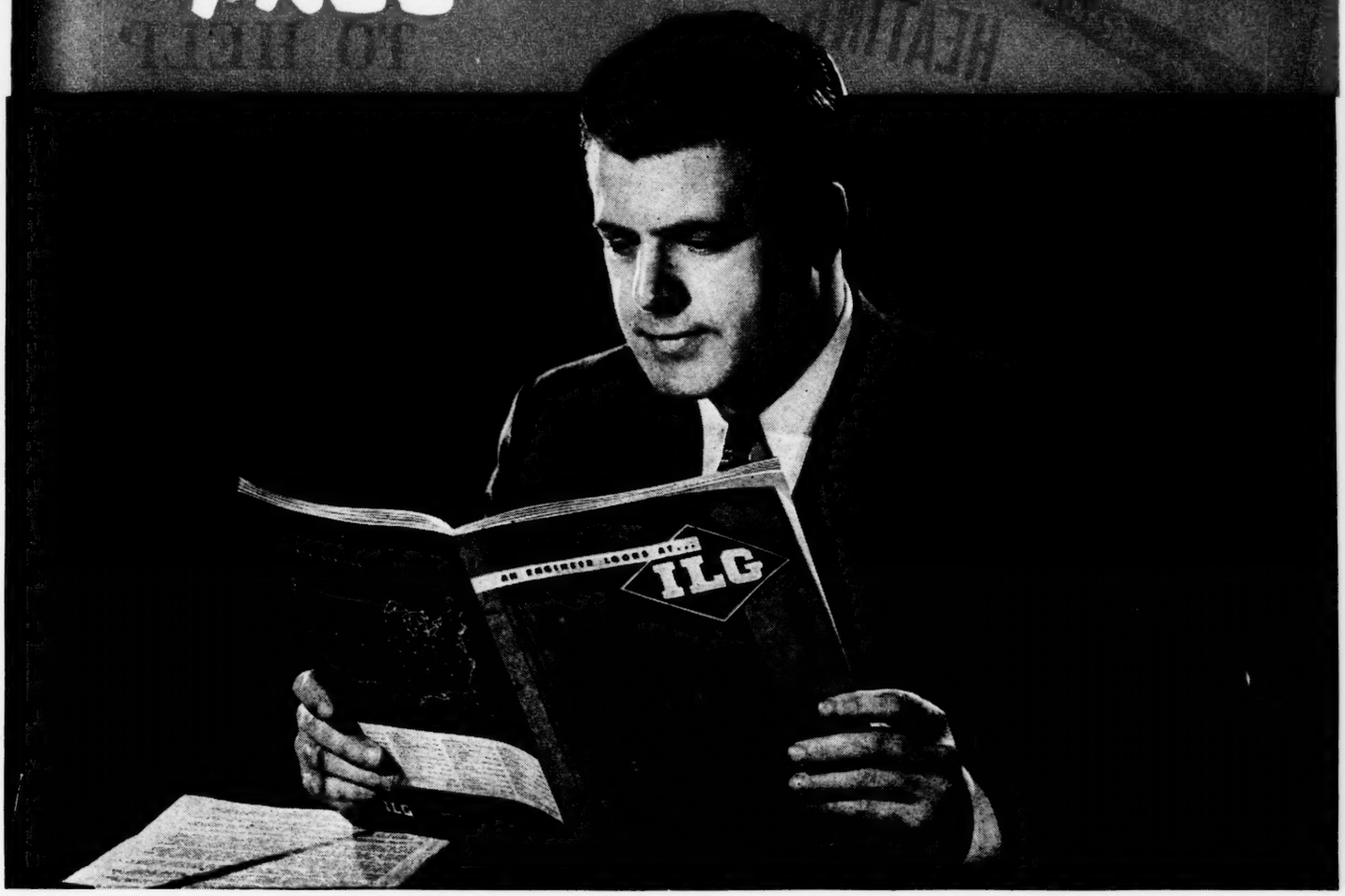

Take a quick trip through the ILG Plant

...from your easy chair!

Look through the eyes of a visiting engineer at the modern ILG Plant. Learn why ILG builds its own motors . . . see the fascinating steps in the manufacture of different types of heating and ventilating equipment. Make a stop at the new ILG Research Laboratory . . . meet the men who concentrate their skills on the development of better apparatus for you.

If you cannot visit the ILG Plant in Chicago, get a copy of this fascinating new photographic booklet. Send coupon or phone nearby Branch Office (consult classified directory).

ILG

VITALIZED VENTILATION

AND AIR CONDITIONING

WANTED: GRADUATE ENGINEERS!

for ILG Branch Offices, also Research and Engineering Departments. Exceptional opportunities now and in the future for graduates of accredited technical schools. Send details on education, experience. health, age, marital status.

ILG ELECTRIC VENTILATING CO., CHICAGO 41, ILL.
2858 North Crawford Avenue, Offices in 40 Principal Cities

☐ Rush free copy "An Engineer Looks at ILG" Booklet.

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Individual _____ Title _____

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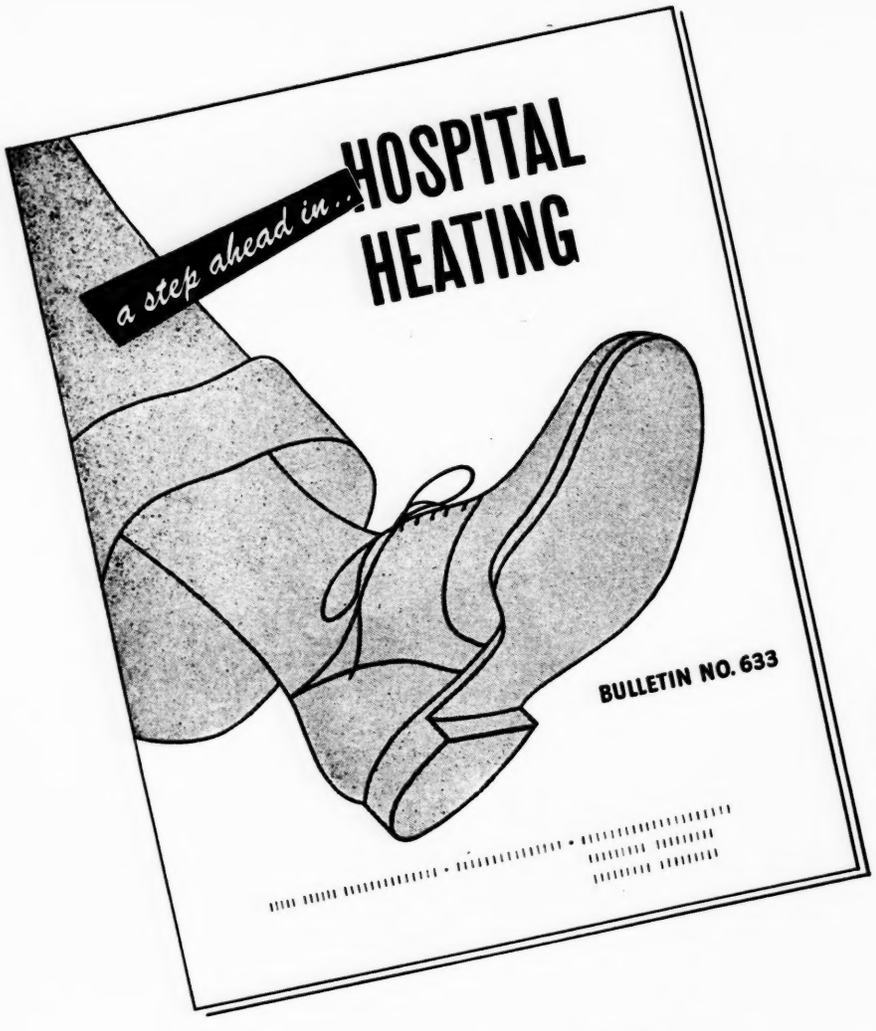

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It has been based on the hospital because this field commands immediate interest for two reasons.

It embraces a tremendous potential of business; a challenge to the ambitious.

Quite aside from the human significances, no other type of building more clearly requires the flexibility, economy and utter competence which characterizes the Dunham Differential System of Heating.

"A step ahead in Hospital Heating" is a form of public relations for the architect and engineer. It will be sent, without obligation, to you personally or to any of your clients whom you may designate. C. A. Dunham Co., 450 East Ohio Street, Chicago 11, Illinois.

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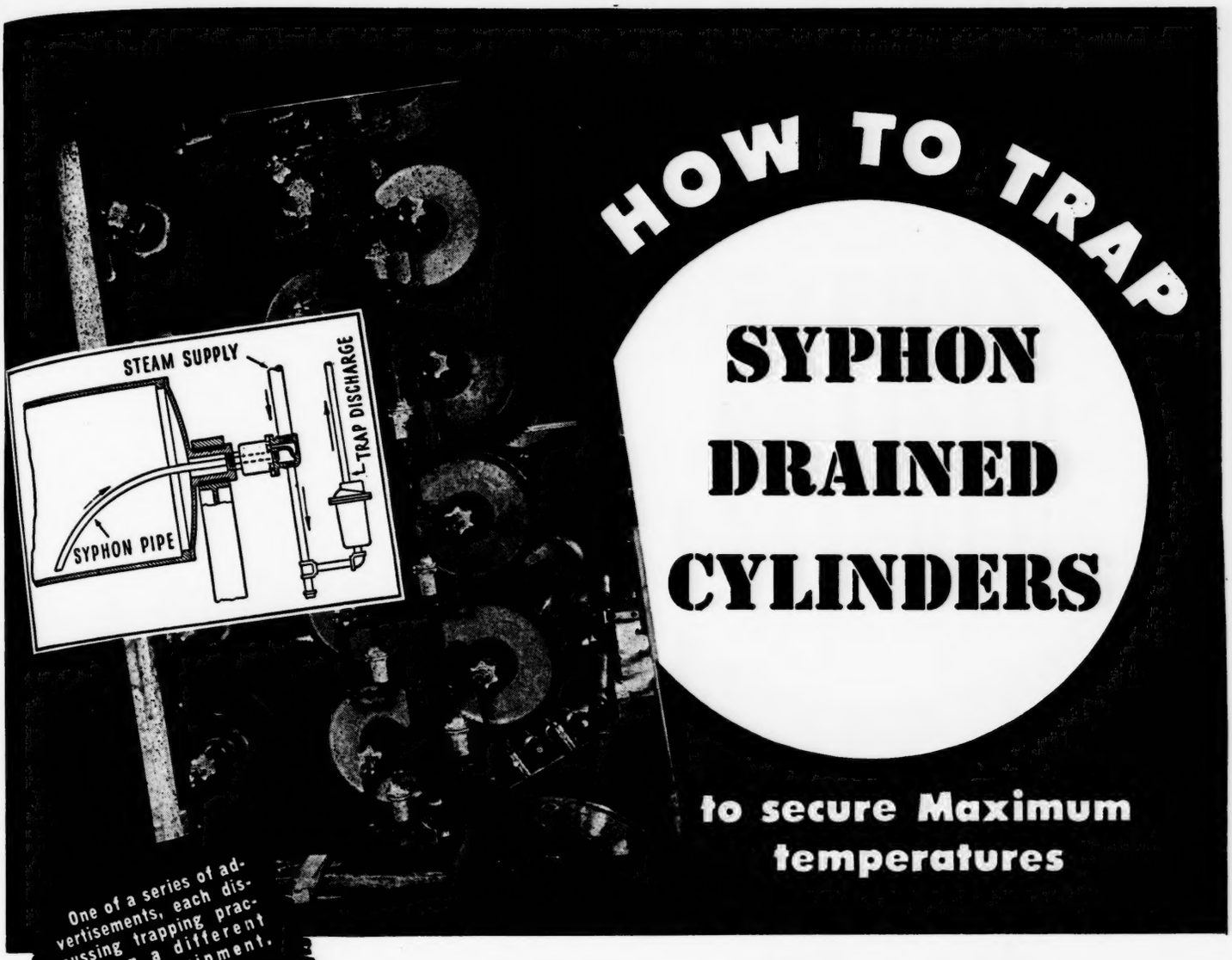
DUNHAM

DIFFERENTIAL HEATING

CHICAGO • TORONTO • LONDON



HOW TO TRAP SYPHON DRAINED CYLINDERS

to secure Maximum temperatures

One of a series of advertisements, each discussing trapping practice on a different class of equipment.

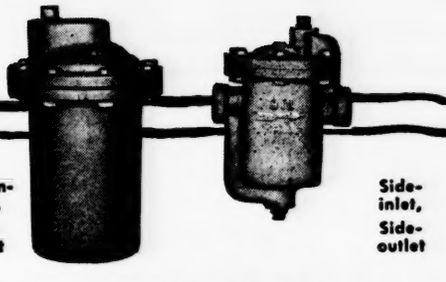
Paper Company Raises Temperatures of Corrugating Rolls 50%

Drainage of condensate from dry cans, slashers, sizers, corrugating rolls, double drum dryers and similar equipment requires a *practical experience* in installation practice plus traps capable of handling air as well as condensate. Armstrong offers both.

As a result, engineers have been surprised to find that despite previous trapping, Armstrong trap installations can effect results like these:

A Pittsburgh paper company raised corrugating roll temperatures 50% . . . a textile mill installed 200 Armstrong traps on dry cans after tests showed higher temperatures . . . Hyde Park Laundry, Chicago, increased ironer production 28%.

An Armstrong representative will be glad to call at your request. ARMSTRONG MACHINE WORKS, 846 Maple St., Three Rivers, Mich.



Trapping Tips*

- Be sure syphon pipe is curved downward, with the end of the pipe close to the shell.
- Use traps with ample air venting capacity.
- Be sure there is no dirt in syphon pipe and end is not burred.
- Use a trap on each cylinder.
- Be sure there are no leaks in syphon pipe.

*Complete, useful data contained in 36 page ARMSTRONG STEAM TRAP BOOK. Write for a copy — free on request.

ARMSTRONG STEAM TRAPS

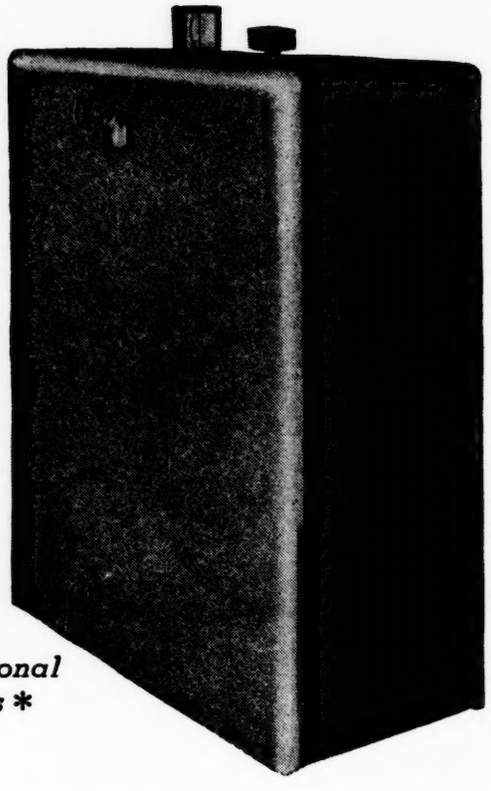
Over a Million in Use...For Power...Process...Heating

Dependable

THROUGH **HALF A CENTURY!**

1894

1945



No. 1 of a Series of National Heat Extractor Boilers *

There's a husky, dependable heating plant concealed beneath the modern, colorful jackets of National Heat Extractor boilers. An efficient heating plant developed through more than fifty years of constant research and improvement.

The No. 1 Series Heat Extractor illustrated has, as one of its features, a water-cooled safety base for installation in kitchen or utility room. Compact and dependable, the No. 1 series is especially designed for smaller homes.

* *There's an NRC product to fit every building need.*

NRC

The NATIONAL RADIATOR Company

JOHNSTOWN, PENNSYLVANIA

How Sarco Serves in
2 LSI ELECTRIC CONTROLS
21 TEMPERATURE REGULATORS FOR PROCESSES
5 87C THERMOTON CONTROLS FOR PLATING
85 STRAINERS UP TO 3"
197 FLOAT-THERMOSTATIC STEAM TRAPS 3/4 to 2"
7 SCRAPER STRAINERS 1 1/4 and 1 1/2"
12 DIAL THERMOMETERS
274 BUCKET STEAM-TRAPS 1/2 to 1 1/4"
22 RADIATOR VALVES
27 SH 65 RADIATOR TRAPS

THE MODERN FACTORY

Here is a typical case with no name mentioned, because it is a defense plant. The industrial company and their contractor decided to standardize on Sarco for all steam traps and temperature control because in their years of experience in connection with many other jobs, there was no other line as broad and versatile and as reliable.

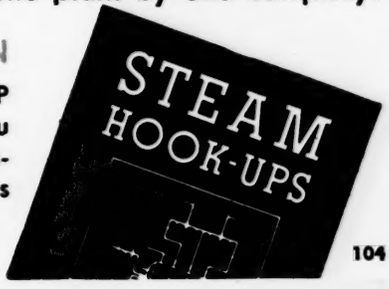
The illustration above shows the extent to which eight different but related Sarco products were used in this one plant, and the wide range of sizes required. Team work in operation was obviously secured.

Other advantages of standardization with Sarco are:

Ease of inspection and cleaning without disturbing the piping. Small number of spare parts required in stores. Ease of obtaining duplicates for additions or extensions, and the knowledge that all parts were made in one plant by one company.

WHEN YOU PLAN

get the Sarco HOOK-UP BOOK which will show you how completely and satisfactorily Sarco products can serve your plant.



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FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

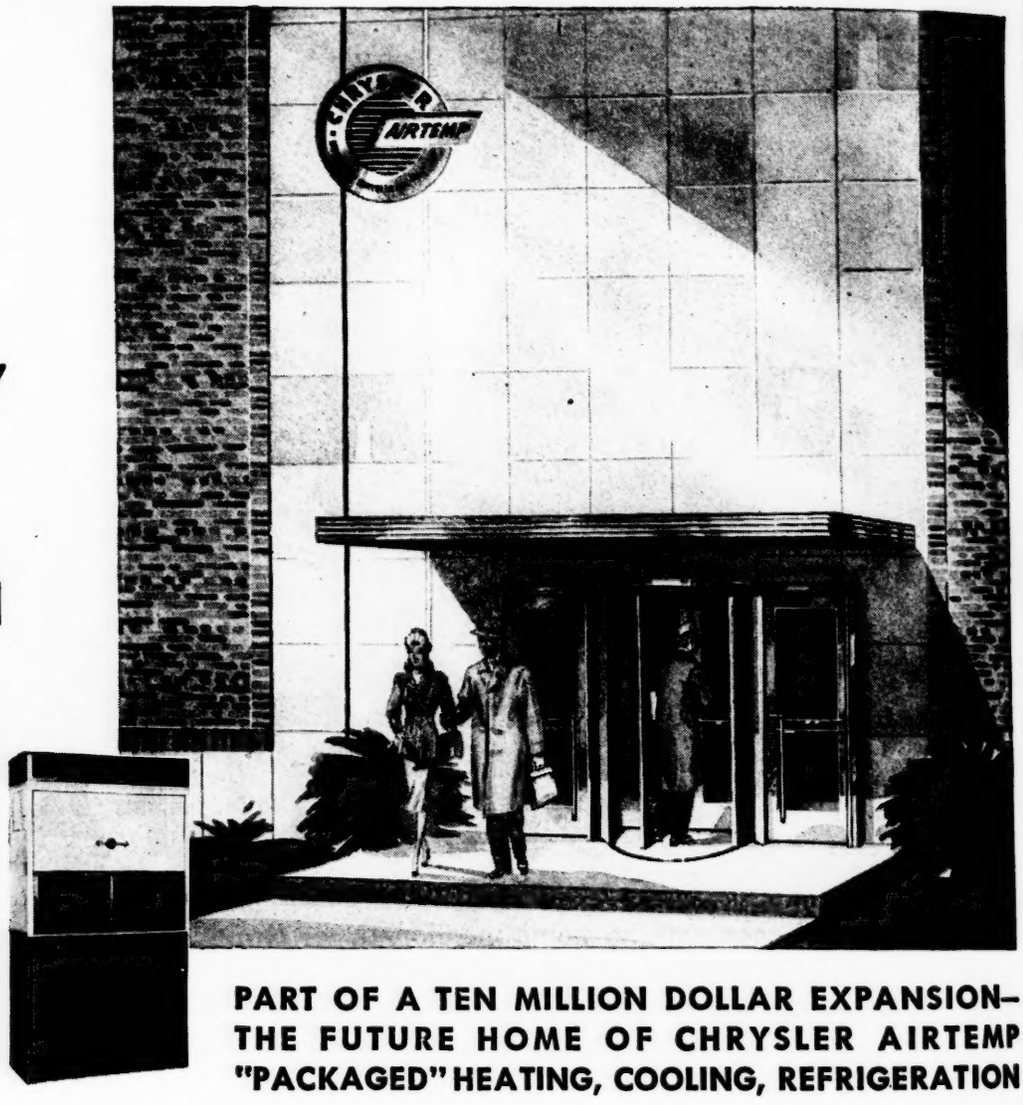
SARCO SAVES STEAM

Represented in Principal Cities

SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y. • Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.

CHRYSLER AIRTEMP

Doorway to a New Era



PART OF A TEN MILLION DOLLAR EXPANSION—THE FUTURE HOME OF CHRYSLER AIRTEMP "PACKAGED" HEATING, COOLING, REFRIGERATION

This is the entrance to the new home of Chrysler Airtemp at Dayton, Ohio.

Inside the windowless walls of this ultra-modern plant, temperature and humidity will be fully controlled every day of the year. Here the most modern mass production facilities will be employed making it possible for millions to enjoy the benefits of year 'round air conditioning in homes, offices, stores, shops and industry. A new era for Americans is just around the corner.

Back in 1937, Chrysler Airtemp pioneered "packaged" air conditioners with the famous scaled radial compressors. Today, a wide range of heating, cooling and commercial refrigeration products are bringing new comfort, protecting health and promoting efficiency throughout the world.

When you have an air conditioning or refrigeration problem, it will pay you to discuss it with Chrysler Airtemp. There is a capacity range ideal for practically every need. • Airtemp Division of Chrysler Corporation, Dayton 1, Ohio.

Buy Victory Bonds—Listen to the music of Andre Kostelanetz, Thursday, CBS, 9:00 p.m., E.S.T.

HEATING • COOLING • REFRIGERATION

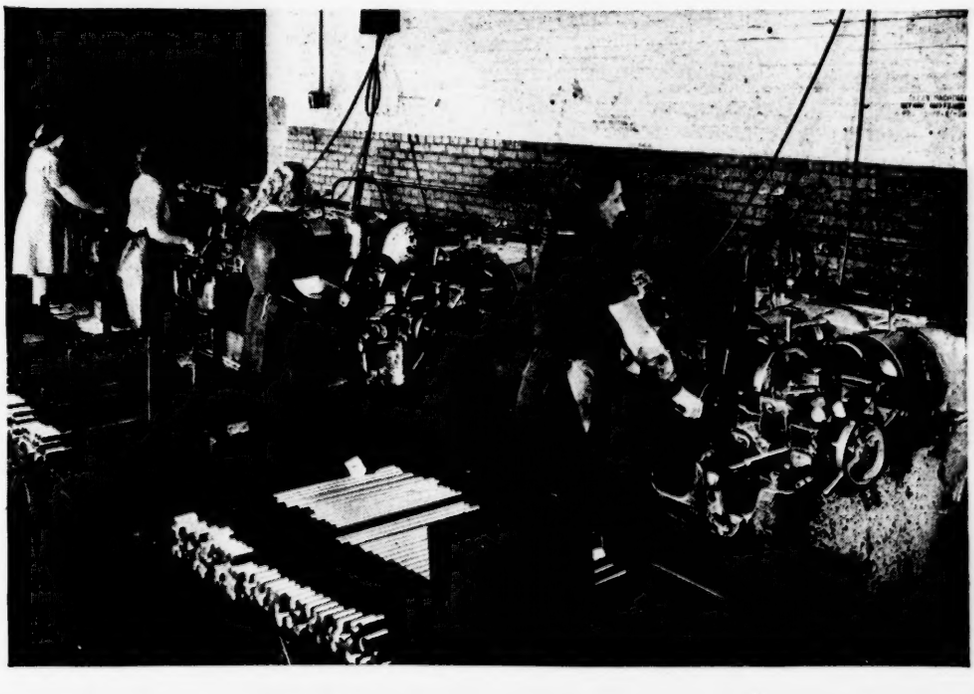
QUALITY CONTROLLED TO THE LAST THREAD

From billet to the final threading, the processing of every circle Ⓑ bolt and fastener is controlled in one plant—the largest integrated independent in the country. This accounts for the uniform dependability and accuracy of Buffalo Bolt Products.

BUFFALO BOLT COMPANY

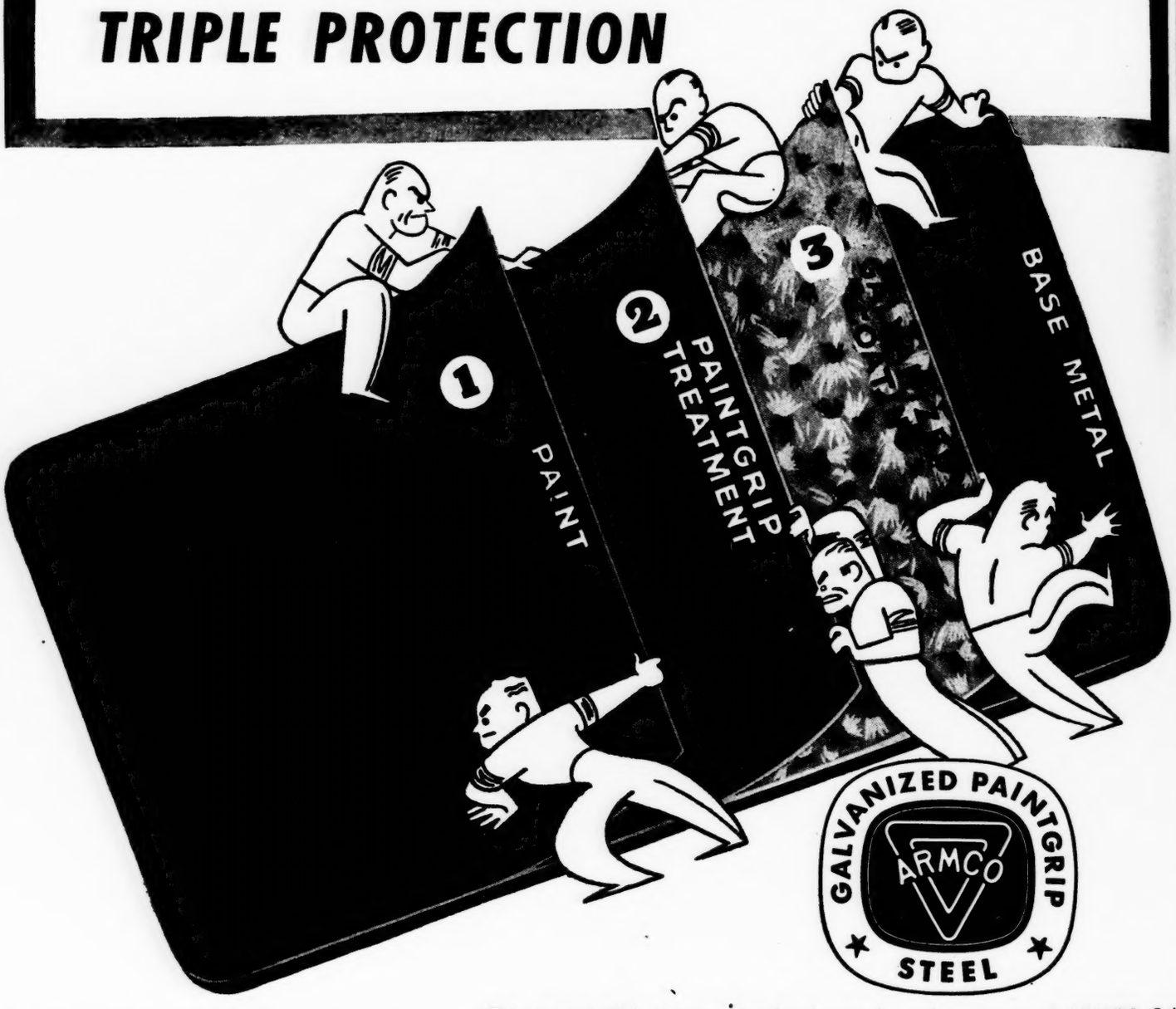
NORTH TONAWANDA, NEW YORK
SALES OFFICES IN PRINCIPAL CITIES

Ⓑ



A few of Buffalo Bolt Company's modern threading machines.

If it's to be painted insist on this *TRIPLE PROTECTION*



See Sweet's Catalog for uses, advantages and general specifications of these Armco special-purpose sheets:

Galvanized ARMCO Ingot Iron.

ARMCO Galvanized PAINTGRIP Steel (also available with ARMCO Ingot Iron or Copper-Steel base)

ARMCO Stainless Steels

The "Scratch Test" shows how paint sticks to ARMCO Galvanized PAINTGRIP. The top half of the sample is Bonderized at the mill. When scratched with a penknife only a slight mark can be seen. Paint on ordinary galvanized steel (bottom half) scrapes off readily.

This "peel-off" picture clearly shows the advantages of ARMCO Galvanized PAINTGRIP Steel for *all sheet metal work to be painted.*

No. 1 is the smooth, tight paint finish that can be applied as soon as the work is done, and which lasts several times longer than paint on ordinary galvanized or uncoated sheets.

No. 2 is the special mill-Bonderizing that takes and preserves the paint without pre-treatment. No fuss, no bother, no added cost.

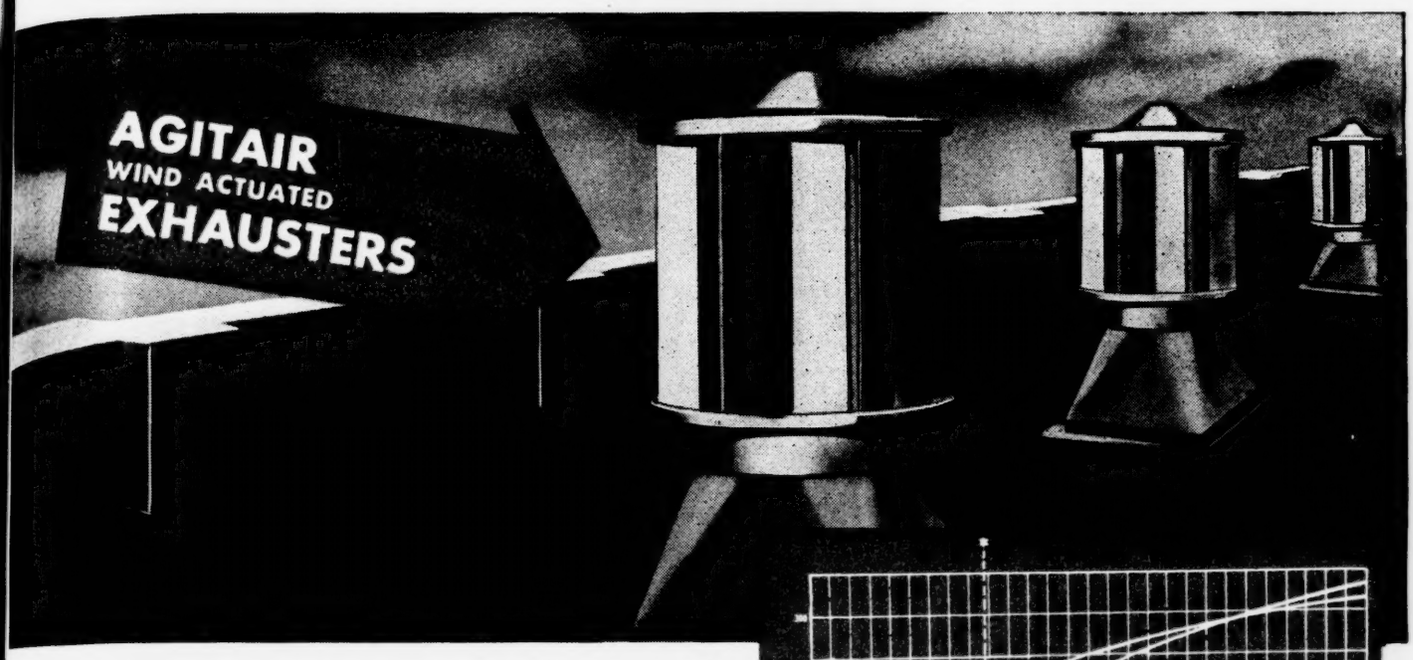
No. 3 is the full-weight galvanized coating that protects the high-quality iron or steel base from rusting.

Remember, it actually costs less to use ARMCO Galvanized PAINTGRIP than ordinary galvanized and acid-etch it before painting. You get a smooth job in less time and it stays attractive longer. Exposed air ducts, furnace casings and other painted work—these are just a few of the heating and air conditioning uses.

Write for the ARMCO PAINTGRIP booklet, which gives complete information on fabricating, finishing and applications of this special sheet steel. The American Rolling Mill Co., 1721 Curtis St., Middletown, Ohio.

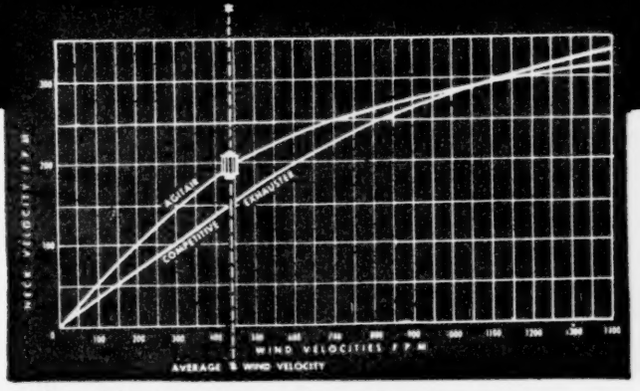
THE AMERICAN ROLLING MILL COMPANY

Special-Purpose Sheet Steels



EXHAUST UP TO 50% MORE AIR . . .

At Average Wind Velocity



Agitair Exhauster gives superior performance at average low wind velocities, as shown by this test report. This does not include allowance for stack effect, which becomes negligible when an effective breeze is blowing.

A good wind-actuated air exhauster, when used as a ventilator for all types of buildings, or as a flue cap for oil or gas-fired equipment:

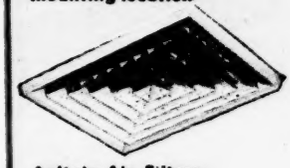
1. Will not restrict the flow of air or gases when there is no breeze.
2. Will not interfere with natural draft due to stack effect. If it does, the effectiveness is less than a hole in the roof.
3. Will be weatherproof under all conditions.
4. Will prevent back-drafting when properly installed.
5. Will function at peak efficiency at average low wind velocity, no matter which way the wind.

Tests simulating roof-top conditions prove Agitair Exhauster serves best—sucking out as much as 50% more air at average 5 mph. wind velocity. Does not backdraft. Wide orifices permit maximum natural draft. Weatherproof. No moving parts.

Bulletin EX-101 will show you how to apply this better performance to your ventilating and flue-cap jobs.

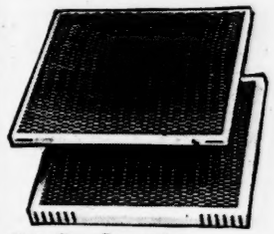
OTHER AGITAIR PRODUCTS

Type R Air Diffusers shaped to fit any room from any mounting location



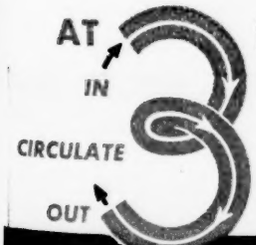
Circular Air Diffusers in all types and sizes.

Agitair Air Filters stop more dirt and hold more dirt.



Hot Water Generators, oil burning, for hot water service.

Hot Gas Generating Furnaces, for chemical and food processing and drying.



KEY POINTS IN AIR CONDITIONING—AGITAIR SERVES BEST

1 FILTERS

2 DIFFUSERS

3 EXHAUSTERS

and also HOT WATER GENERATORS *etc.*

AIR DEVICES, INC. · 17 EAST 42nd STREET · NEW YORK 17, N. Y.

The Clean Air Zone
HAS COME TO
"MAIN ST."

SAVING MILLIONS ANNUALLY FOR BUSINESS AND INDUSTRY

Office buildings, banks, department stores, theatres, libraries, drug stores, business houses of all kinds—from one end of Main Street to the other—are recognizing the importance of *clean air* in their establishments. Economically, *clean air* is saving millions of dollars annually by reducing building upkeep—more millions in reducing merchandise spoilage. Costly dust, soot and smoke need not be tolerated, for AAF Electronic Air Filters are designed to meet every clean air requirement. Send today for free Electro-Matic Bulletin No. 250D—you'll find it helpful in overcoming your dirty air problems.

AMERICAN AIR FILTER CO., INC., 294 Central Avenue, Louisville 8, Kentucky

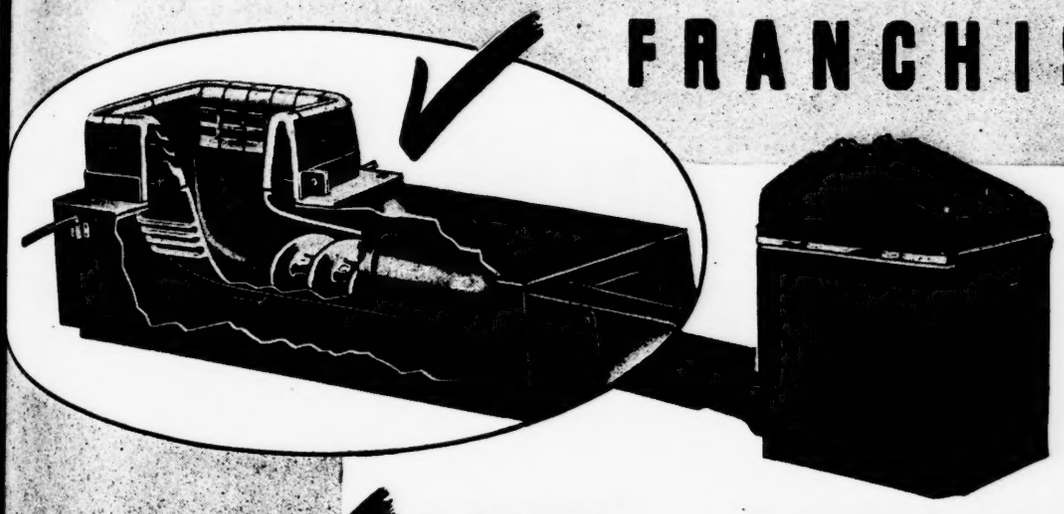
In Canada: Darling Bros., Ltd., Montreal, P. Q.

Electro-MATIC

THE AAF ELECTRONIC AIR FILTER

What YOU Get out of a . . .

FIRE TENDER FRANCHISE



In Residential, Commercial and Industrial Models

The ONLY Stoker with The "ECONO-MIXER"

The Exclusive ECONO-MIXER is the FIRE-TENDER secret of more perfect combustion. Fire-Tender, with the Econo-Mixer, does more to give even, controlled heat at less cost than a gas burner, oil burner or any other stoker in the market. It is the greatest selling feature in the whole stoker industry today! It makes MORE Sales!

YOUR SALESMEN GO OUT EQUIPPED WITH THE MOST COMPLETE, ORDER CLOSING SALES EASEL PRESENTATION IN THE INDUSTRY

No expense was spared in the preparation of this impressive Sales Easel. Printed in 3 colors, varnished, bound with linen, it covers everything from "what is a stoker" to the prepared proposal form and order sheet in the back. It is complete, authoritative . . . with it a salesman can't go wrong . . . it SELLS!

THE HOW-TO-SELL FIRETENDER SALES MANUAL, THE MOST UP-TO-THE-MINUTE SELF SALES TRAINER — A YEAR IN THE WRITING

This 80 page booklet is a masterpiece of FIRETENDER salesology. It's full of sure-fire prospecting, demonstrating, order getting sales methods. Cartoon illustrated for liveliness and punch, it teaches SALESMANSHIP in the most fascinating, effective manner we have ever seen.

THE SELLING PLAN IS THE THING!

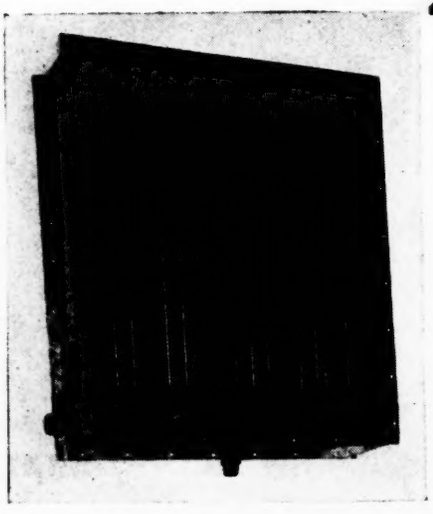
Our new merchandising plan puts more stokers in homes than any other plan yet developed.

ALL THIS MEANS YOU GET MORE MONEY!

Tear This Off — Paste on Your Letterhead and Mail It in For FULL INFORMATION.

Name.....

Title.....



MONSOON HEATING COILS—Two header and non-freeze types with inner tube steam feed. Extended surface coils permit high rate of heat transfer and remarkably low resistance airflow. Available in a wide variety of sizes for immediate delivery.

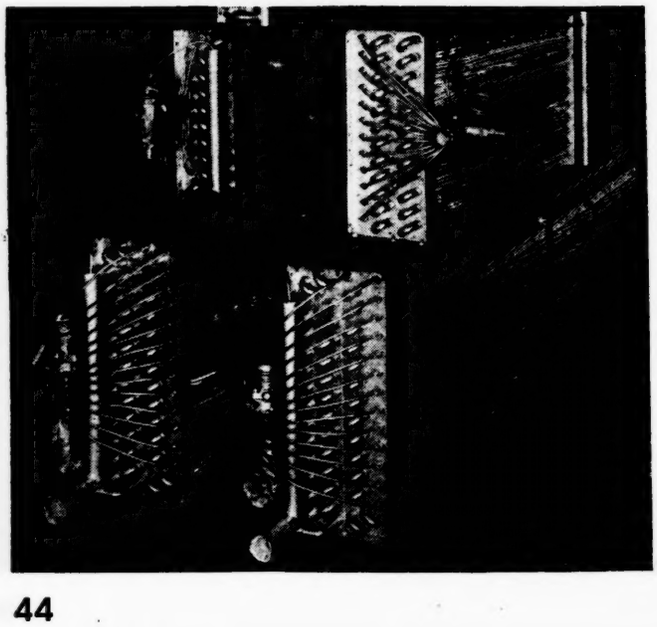
•

COILS

ALL MONSOON COILS CAN BE FABRICATED TO SPECIFICATION IN ANY SIZE OR SHAPE FOR IMMEDIATE DELIVERY.

•

MONSOON DIRECT EXPANSION COILS AND COILS FOR WATER COOLING—Available in a wide range of sizes with circuits designed to provide for even distribution of liquid. Immediate delivery.



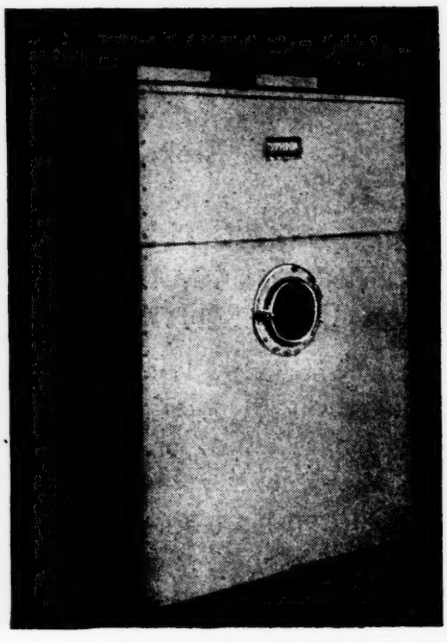
Future Business – NOW

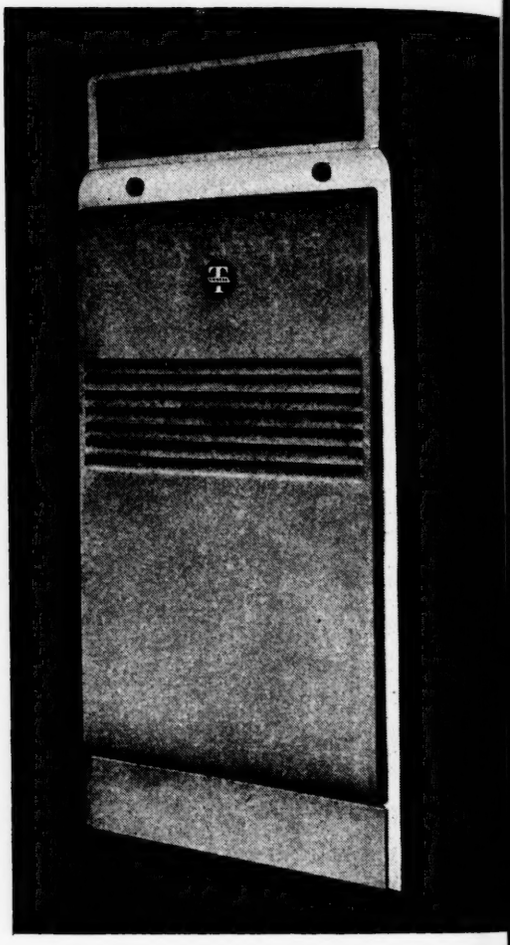
No need to postpone that job for lack of proper equipment. Tested air conditioning equipment for smooth performance in all types of conditioning systems is now available for immediate business.

PROP-R-TEMP—3 and 5 ton self-contained air conditioning units. Easy to install, inexpensive to operate, moving parts completely accessible, PROP-R-TEMP units are again available in limited quantities.

•

TYPHOON EVAPORATIVE CONDENSER—Coil surface and air quantities designed to keep air pressure and power requirements to a minimum under toughest conditions of temperature and humidity. Compact, efficient, available in a range of sizes from 5 to 150 tons.





COOLING AND HEATING EQUIPMENT

- **Prop-R-Temp Self-Contained Units, 3 and 5 Tons**
- **Typhoon Evaporative Condensers**
- **Typhoon Spray Coolers (Air Washers)**
- **Prop-R-Temp Air Conditioning Units**
- **Monsoon Heating Coils (2-Header and Non-Freeze Types)**
- **Monsoon Direct Expansion Coils**
- **Monsoon Water Coils (Continuous Tube and Free Drain Types)**

Several dealer territories open. Inquiries and orders receive prompt attention. Write, wire or phone.

ICE-AIR

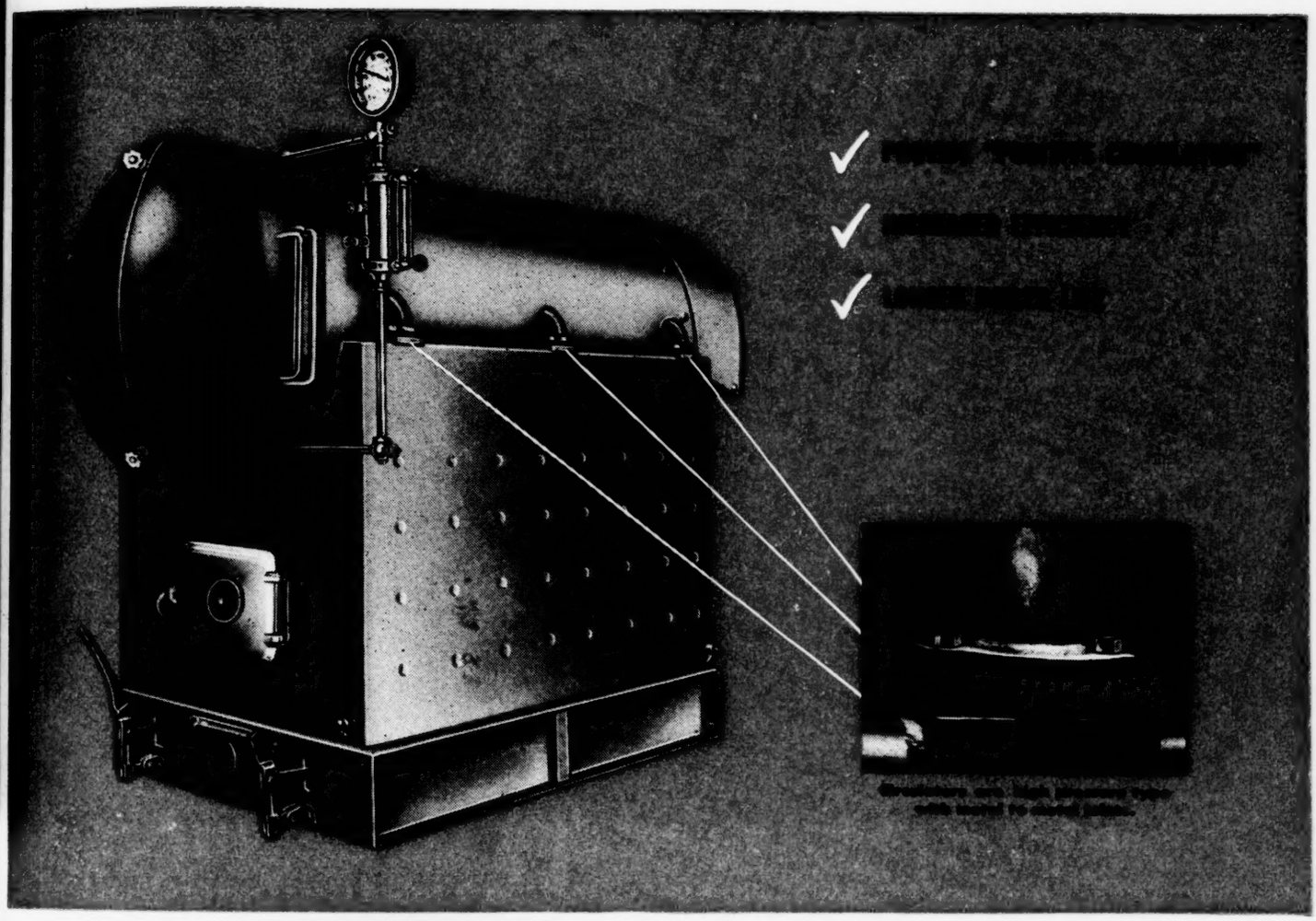
CONDITIONING CO., INC.

252 West 26th Street, New York 1, N. Y.

TITUSVILLE

MODERN IMPROVED *Compact*

STEEL HEATING BOILERS



19 STANDARD SIZES IN HAND OR MECHANICAL FIRED

Just as a pump on a forced hot water heating job steps up circulation and increases heating results, the *Side Circulators* in Titusville Compact Boilers assure *positive circulation.*

Titusville *Side Circulators* do the work of a pump —they restrict the openings between the firebox and shell and increase the velocity of the flow of steam and hot water within the boiler.

As a result, steam bubbles that accumulate on and insulate the heating surfaces are continuously washed off and a greater amount of heat is absorbed by the water in the boiler.

New Titusville Compact Boiler Bulletin on request.

TITUSVILLE IRON WORKS CO TITUSVILLE, PA.

THE TITUSVILLE IRON WORKS COMPANY

Division of Struthers Wells Corporation

TITUSVILLE, PA.

District Representatives in Principal Cities

For Plumbing and Heating Conducting Systems...

AIR CONDITIONING AND REFRIGERATION

There are many advantages in an installation of STREAMLINE Copper Pipe and Solder Fittings, both for you and your prospect.

The owner who buys a copper job actually buys long-life insurance for the comfort and livability of his investment. He procures a piping material that is highly resistant to rust and clogging—a system that will, under normal conditions, give him life-long, efficient service. Even in extremely abnormal water conditions, copper is generally the best in the long run.

The plumbing contractor who puts in a copper job, installs a material that is the most practical and handy to use—no back-breaking threading and lifting—less equipment to carry—less weight, and less space required.

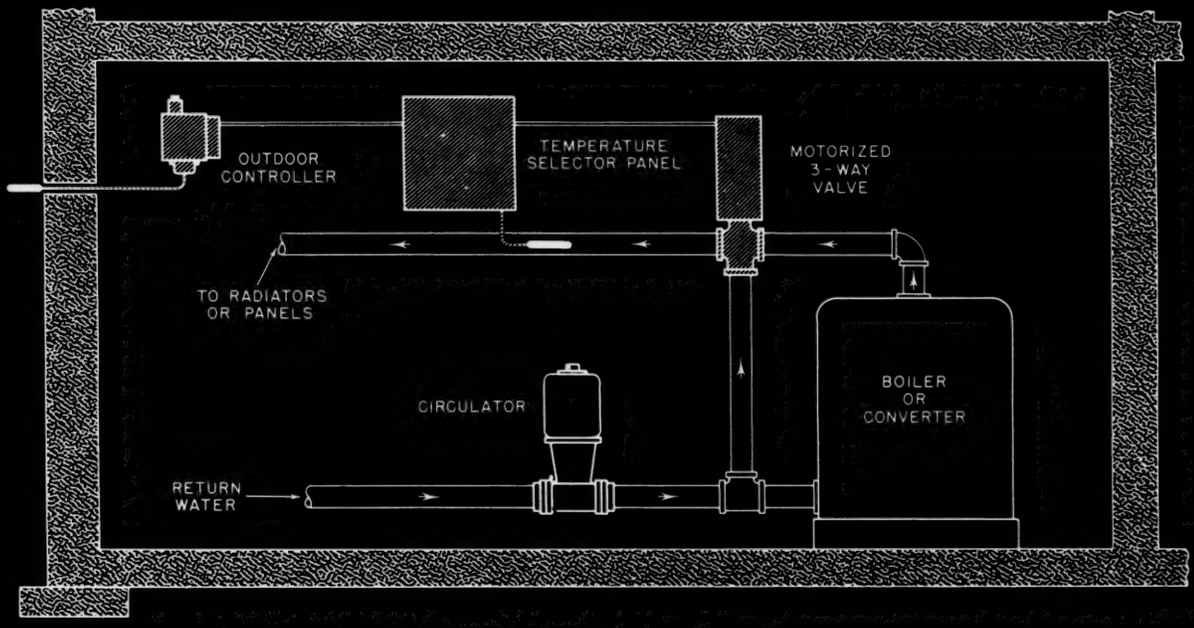
A copper job is a "business-getter." Almost invariably it acts as a "silent salesman" in the procurement of additional jobs. It is a "reputation-builder," and there need be no "comebacks"—the job is right and it stays right.

STREAMLINE is advertised and marketed by this company for the use of experienced mechanics—the plumber and steamfitter. STREAMLINE Copper Pipe and Fittings can be procured only through legitimate plumber jobbers.

STREAMLINE
PIPE AND FITTINGS DIVISION
MUELLER BRASS CO.
PORT HURON, MICHIGAN

STREAMLINE★
TRADE MARK REG. U. S. PAT. OFFICE
COPPER PIPE and Solder FITTINGS

Now You Can . . . .



WHEN outside weather changes, the capacity of the heating plant should vary with it.

This new Honeywell system, in effect does just that for commercial hot water systems. An application of Moduflow . . . this system modulates the temperature of the supply water to a higher degree as the outside temperature falls; and, conversely, to a lower degree as the weather becomes milder. This prevents wasteful and uncomfortable heating in moderate weather and insures quick response to the heating system in severe weather.

This new modern Honeywell equipment can be applied to new or existing heating plants. It is adaptable to all types of hot water heating and to all kinds of automatic burners, and is available for single or multiple zone applications.

If you have not already investigated this new system, do so at once, as it not only saves fuel but produces more even and healthful heat . . . Write for complete information. Minneapolis-Honeywell Regulator Co., 2715 Fourth Avenue South, Minneapolis 8, Minn.

MINNEAPOLIS **Honeywell**

CONTROL SYSTEMS

The Visaflame measures up to modern oil burner boiler and furnace efficiency requirements.

THE REASON IS OBVIOUS

The Visaflame controls the oil burner, guarding against ignition or flame failure directly at the source where it closes its circuit in the presence of light from the oil flame and opens its circuit when such light is absent ★ In this respect it differs from the usual stack control system which depends upon the indirect method of utilizing the heat traveling through the stack to operate the control ★ The Visaflame is not an untried control system. There are thousands in actual service, demonstrating their superiority to anything offered to the trade ★ Available for domestic and industrial applications ★ Our engineers will assist in its application to your burner.

THE MERCOID CORPORATION, 4201 BELMONT AVENUE, CHICAGO 41, ILLINOIS

MERCOID VISAFLAME

The Light Actuated Control System

AN EXCLUSIVE MERCOID PRODUCT

You Can Meet All Your Requirements With

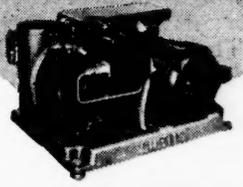
the Complete Line of CURTIS Commercial Refrigeration and Air-Conditioning Units

48 Water-Cooled Condensing Units — 1/3 to 30 H. P.
45 Air-Cooled Condensing Units — 1/4 to 3 H. P.

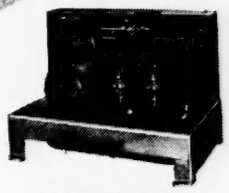
CURTIS offers both dealers and users a complete line of Commercial Refrigeration and Air-Conditioning Units in a wide range of types and sizes.

Curtis Air-Conditioners cool, dehumidify, filter, and circulate the air and are adaptable for heating, if desired. Available as packaged units, needing only power and water connections to install, or as central or remote types requiring ducts.

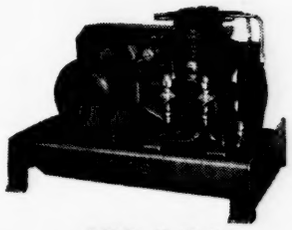
The result of Curtis' advanced engineering and 91 years of successful manufacturing experience is dependable, economical, trouble-free service throughout an exceptionally long life of heavy-duty service.



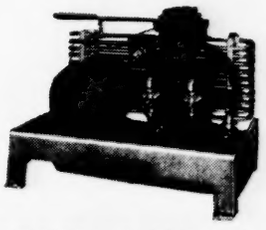
¼ H.P. (cabinet type)



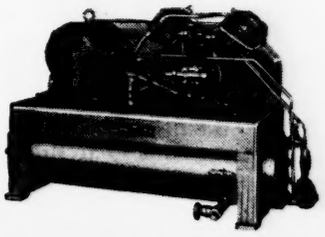
1 H.P. Air-Cooled



3 H.P. Air-Cooled

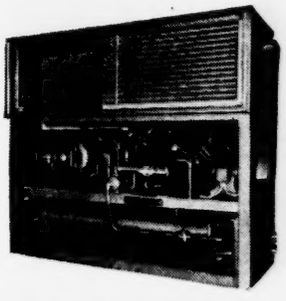


2 H.P. Water-Cooled (counterflow)

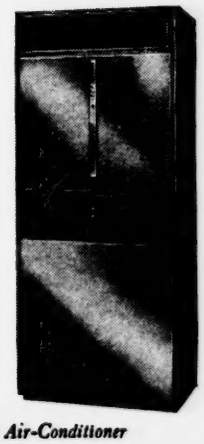


15 H.P. Water-Cooled Shell and Tube

Saturated Air-Condenser



Central Type Air-Conditioner



3 and 5-ton Packaged Air-Conditioner

Other Curtis Products

- ★ Air Compressors (Industrial)
- ★ Air Compressors (Automotive)
- ★ Air Hoists
- ★ Air Cylinders
- ★ Car Washers
- ★ Automotive Lifts
- ★ Curtis Circular Saws

AR-468

Curtis Refrigerating Machine Division
of Curtis Manufacturing Company
1999 Kienlen Avenue — St. Louis 20, Mo.

For the BUGABOO of air-conditioning:

HIGH-FREQUENCY AIR CHANGES with LOW-VELOCITY AIR MOTION

always specify **Type "AR" ANEMOSTAT**

WHY?

The "AR" ANEMOSTAT (just one of a complete line) was specifically designed to solve the extremely difficult problem of air distribution involved in areas requiring *exceptionally frequent changes of air—yet low velocity air motion throughout the conditioned space.* Because of its unique and patented design, this "AR" ANEMOSTAT siphons 30% of the room air into its flaring conical louvers . . . where the room air mixes with the incoming cooled or heated air before it is discharged into the room. ANEMOSTAT'S exclusive air-mixing action — within the device itself — is the only efficient "Aspiration"!

WHEN?

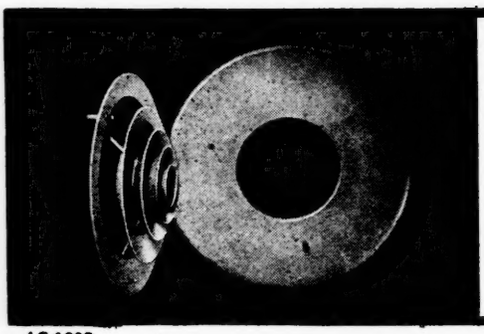
For diffusing large volumes of supply air without objectionable air motions or drafts—even in relatively small areas—this "AR" ANEMOSTAT has no equal. Its exclusive design delivers the utmost in air-conditioning . . . draftless air distribution throughout the entire occupied zone under any temperature differentials normally encountered in cooling, heating or ventilating. For the ultimate in air-conditioning — always specify ANEMOSTAT!

WHERE?

This "AR" ANEMOSTAT functions successfully whether installed on exposed ducts, or tight against the ceiling on concealed ducts . . . in large areas or small rooms . . . and with equal efficiency. Easily installed. Conforms to architectural designs and interior decorations. ANEMOSTAT is the draftless air diffuser that *perfects* any air-conditioning system!

Write today for our new Bulletin "AR".

ANEMOSTAT CORPORATION of AMERICA
10 East 39th Street • New York 16, N. Y.



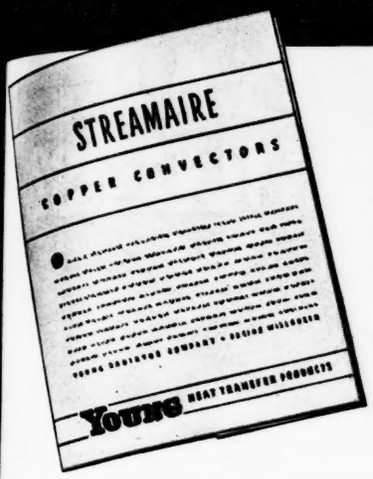
AC-1002

The "AR" ANEMOSTAT is constructed for easy installation. Simply remove 3 screws, and the outer (largest) conical louver with the neck is separated from the inner assembly. After the neck of the outer louver is fastened to the supply duct, the inner assembly is replaced and the installation is completed for all time. No moving parts, no repairs, no adjustments!

There is no substitute for ANEMOSTAT! When you specify ANEMOSTAT for every cooling, heating, or ventilating system, you certify the best in air-conditioning performance — you insure thorough but draftless air distribution—and you avoid the pitfalls that substitutions so often incur. Why not request us to have one of our engineers tell you more about ANEMOSTAT—there's no obligation!

ANEMOSTAT

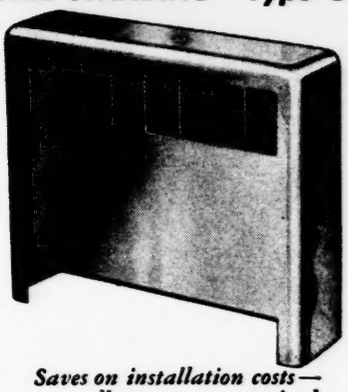
"Streamaire" Convectors
NOW STANDARDIZED IN 4 TYPES



Just off the press, this brand new folder..."Streamaire" copper convectors by Young ... has full information on capacity ratings, complete list of sizes of each style, easily read dimensional drawings and specifications. It can be had for the asking. Write today.

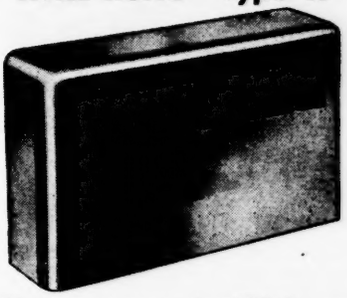
Thousands of installation headaches will be avoided by architects, engineers, and contractors who wisely specify Young "Streamaire" Convectors in one of the four convenient standard types pictured at the right. They can be ordered directly from factory stocks which are being built up as rapidly as raw materials make it possible. These four designs have been scientifically engineered to satisfy a wide range of convector radiation requirements. Easy to order and easy to install, they can be depended upon to provide all of the warm comfort and even temperatures your customers expect. Young convectors are furnished with chain control dampers that make it easy to regulate flow of heat. Write for the pamphlet "Streamaire" Copper Convectors by Young and find out more about this conveniently standardized line of heating convectors.

FREE STANDING • Type C



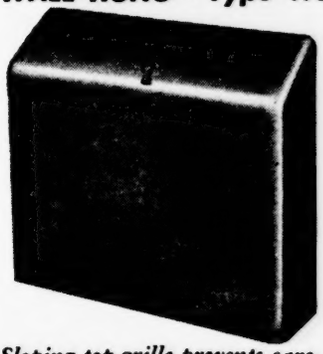
Saves on installation costs— no wall recesses are required.

WALL HUNG • Type W



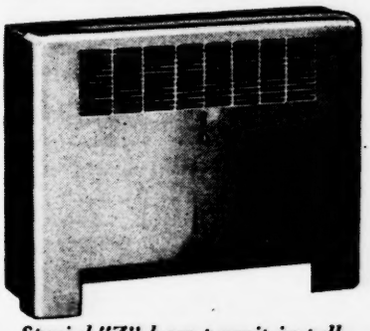
Heating elements accessible by easy removal of one piece front and top.

WALL HUNG • Type WS



Sloping top grille prevents careless blocking of air circulation.

PARTIALLY RECESSED • Type S



Special "Z" bars permit installation before or after plastering.

YOUNG

HEAT TRANSFER PRODUCTS

OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • HEAT EXCHANGERS • ENGINE JACKET WATER COOLERS • UNIT HEATERS • CONVECTORS • CONDENSERS • EVAPORATORS • AIR CONDITIONING UNITS • HEATING COILS • COOLING COILS • AND A COMPLETE LINE OF AIRCRAFT HEAT TRANSFER EQUIPMENT

YOUNG RADIATOR COMPANY • DEPT. 105-M • RACINE, WISCONSIN

WHAT DOES THE NAME STAYNEW MEAN IN AIR FILTERS?

Interior fixtures free from dust and dirt.. they "stay new" longer

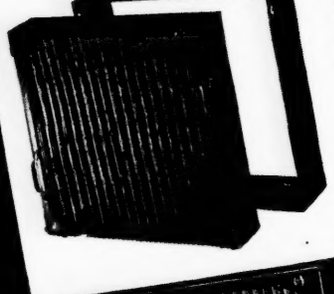
Employees breathing clean dust-free air . . . they work better, feel better "stay new" longer

Filters that are designed to "stay new" longer

GET THE ENTIRE STORY

STAYNEW FILTERS MEET EVERY VENTILATION REQUIREMENT

AUTOMATIC FILTER: Delivers large volume of clean air at low cost. Three exclusive features: (1) *Two* endless curtains, first only entering oil bath. The second curtain removes traces of entrained oil and finer dust particles. (2) Double series of air jets that clean and "condition" each curtain. (3) Curtain rotation is such that air passes last through *cleaned* side of each curtain. *No other filter has these three important features.*



VISCOUS PANEL FILTER: Scientifically designed for all applications where use of a viscous type filter is indicated. The filtering medium consists of a series of alternately crimped layers of galvanized screen cloth and woven mesh. When coated with the proper filter oil, this medium forms an unusually efficient filter. The arrangement of the medium in the metal cell provides extremely large dust-holding capacity. Cells are held tightly in box-like supporting frames and sealed against air leakage by means of cam-type locking latches.

WIRE-KLAD FILTER: Dry-type, fire-resistant. Fin construction provides large filtering area. Medium is supported and protected by rust-resisting screen cloth on *both* sides. The two layers of screen cloth rapidly dissipate heat, making the filter highly flame-resistant. Media available to meet a wide variety of operating conditions. Filter can be cleaned easily and repeatedly either by vacuum, pressure, or (with most media) by *washing*. Cells are supported and sealed against leakage as in Viscous Panel (above).

What's New In Staynew Filters?

Noted since 1921 for advanced ideas in filtration, Staynew was never in better position to go forward. Today, Staynew products are built in a new and larger plant. Their design and operating efficiency is being continually improved in a new and ably staffed testing and experimental laboratory.

Increased engineering facilities are not only producing new models and improving old ones, but are providing the closest possible cooperation between factory and user.

WRITE FOR COMPLETE CATALOG

Representatives in Principal Cities

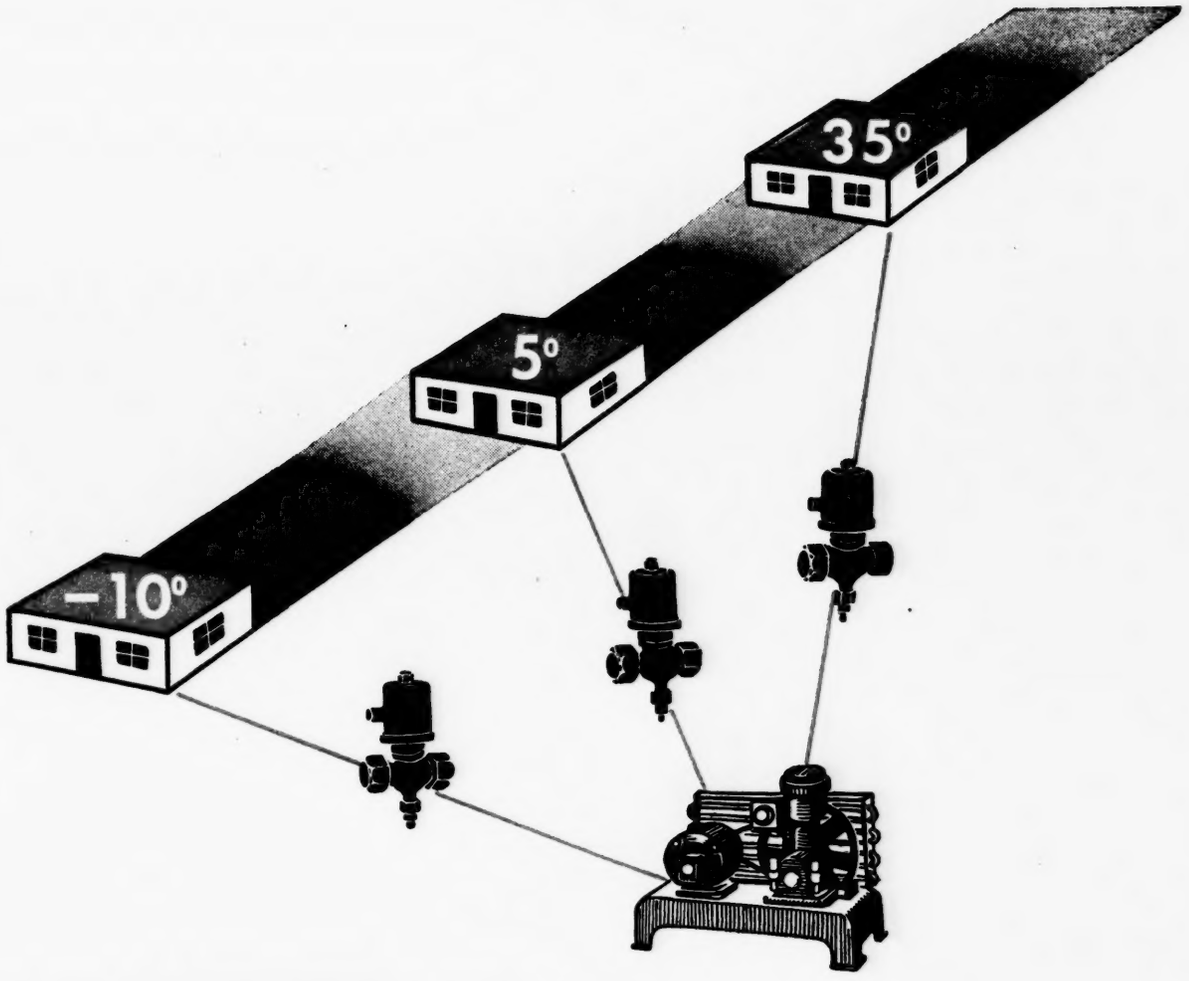
DOLLINGER CORPORATION

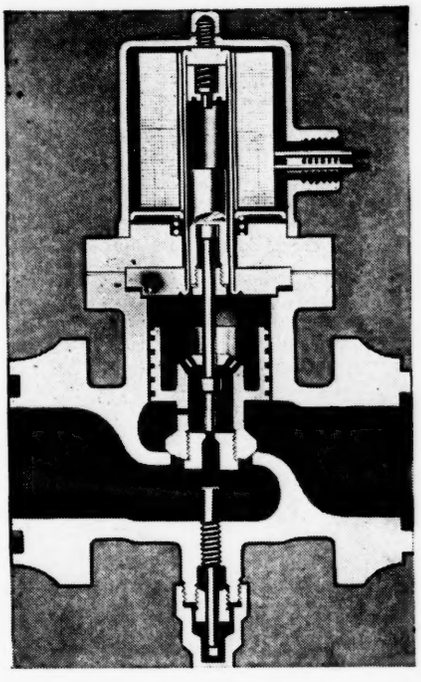
(Formerly Staynew Filter Corp.)

15 CENTRE PARK
ROCHESTER 3, N. Y.

STAYNEW PROTECTOMOTOR FILTERS

"Filter Headquarters"





FOR

MULTIPLE TEMPERATURE CONTROL

ALCO SOLENOID VALVES

...Fully Automatic

When you want to keep two or more rooms at different temperatures, instant-acting Alco Solenoid Valves are the answer.

They control the refrigerant flow automatically with "pin point" accuracy and are electrically actuated by the temperature of the space to be cooled.

This is just one of the many applications to assure automatic positive flow control. For complete details, send for our Solenoid Bulletin.

Designers and Manufacturers of Thermostatic Expansion Valves; Pressure Regulating Valves; Solenoid Valves; Float Valves; Float Switches.

ALCO VALVE CO.

859 KINGSLAND AVE. • ST. LOUIS 5, MO.

Which will it be in a highly competitive tomorrow?

EFFICIENT business never has money to burn — a fact that will prove doubly important tomorrow when every expenditure will count heavily in a keenly competitive market.

Yet, while your boiler plant equipment remains outmoded, you may be tossing $10 (or more) out of every $100 paid out for the production of steam, right into the fire. You're simply not securing *full* use of your oil or gas.

That's where Todd Automatic Burners for liquid or gaseous combustion mean the *profitable* difference between high and low-cost steam.

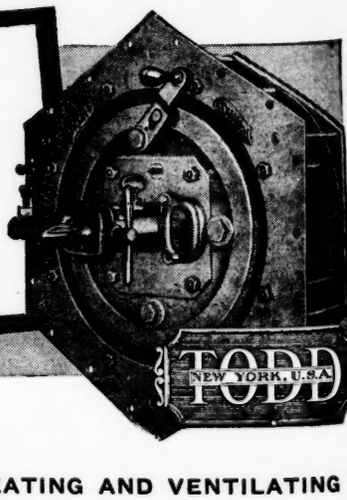
Regardless of the type specified, Todd oil or gas burners actually shave steam production costs up to 10% or better. At the same time, they step up power capacity to maximum and cut maintenance charges to the bone.

For *cheaper* production of power and heat, for industrial or commercial use, you're *combustion-wise* when you *modernize* with *Todd.* Our engineers are at your ready disposal for consultation on your specifications.

ARMY E NAVY

COMBUSTION EQUIPMENT DIVISION
TODD SHIPYARDS CORPORATION
601 West 26th Street, New York 1, N. Y.

NEW YORK, BROOKLYN, ROCHESTER, HOBOKEN, NEWARK, PHILADELPHIA, SO. PORTLAND, ME., BOSTON, SPRINGFIELD, MASS., BALTIMORE, WASHINGTON, CHICAGO, GRAND RAPIDS, TAMPA, GALVESTON, HOUSTON, MOBILE, NEW ORLEANS, LOS ANGELES, SAN FRANCISCO, SEATTLE, TACOMA, MONTREAL, TORONTO, BUENOS AIRES, LONDON



Ever See a *Conscience* being *Assembled?*

ONE OF THE REASONS 6 OUT OF 10 PICK U. S. GAUGES

WHY A GAUGE DOES RIGHT BY YOU

What you prize most in a gauge is accuracy. U. S. Gauges, like all self respecting U. S. instruments, "tell the truth." One reason: they have a marvelous mechanical "conscience," a movement you can count on, made to tolerances as low as .0005", even when gang assembled!

All U. S. gauge movements are built wholly within the shop of U. S. Gauge.

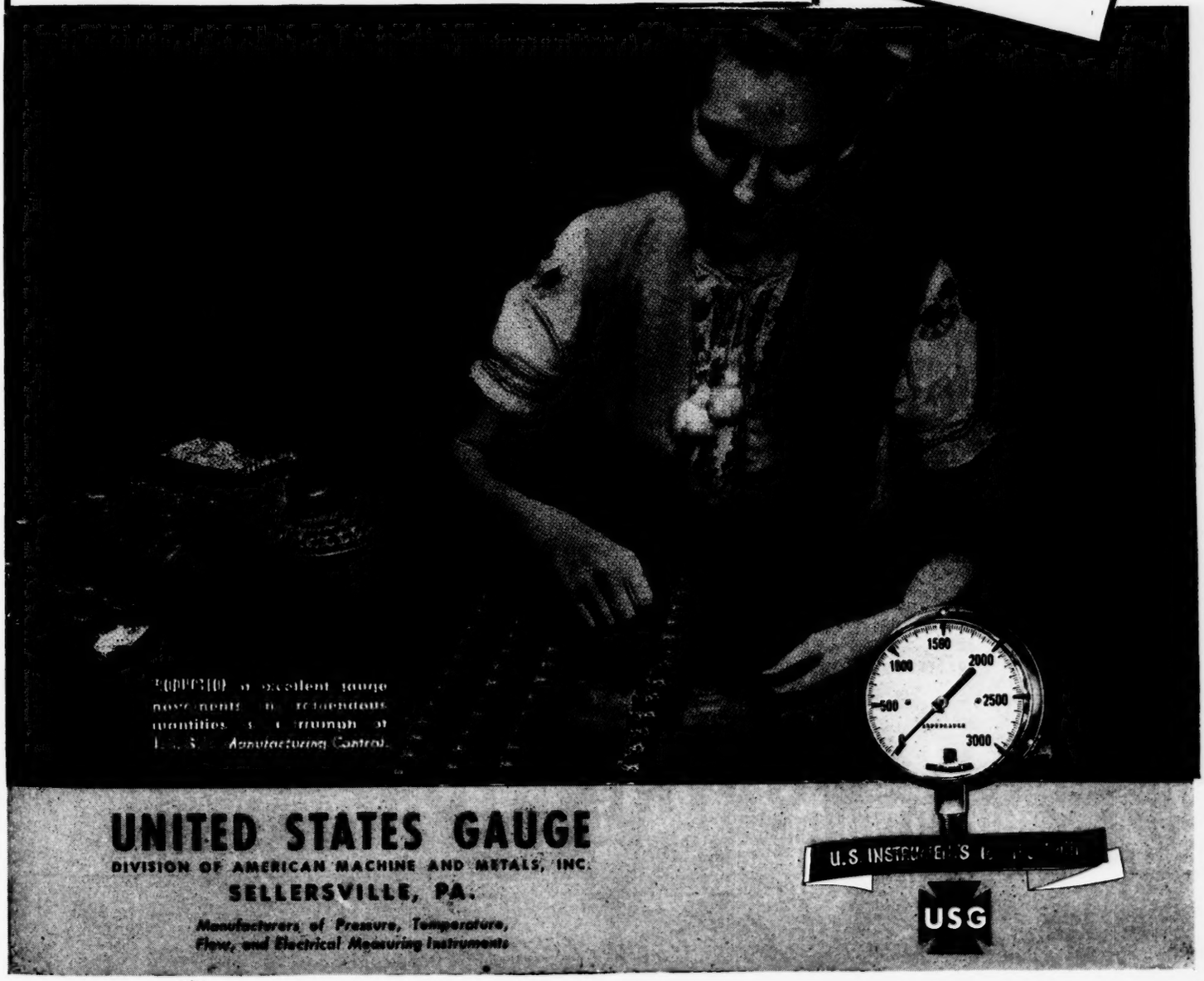
WHY 6 OUT OF 10 CHOOSE U. S. GAUGE

The assembly of a gauge movement weds a number of small, precisely made parts . . . but it's only one step in U. S. gauge-making. Secret of the preference for U. S. Gauges is the application of *Manufacturing Control* to all steps . . . from raw material to production, assembly, calibration, testing, inspection. Over 6 out of 10 original equipment buyers choose U. S. G.

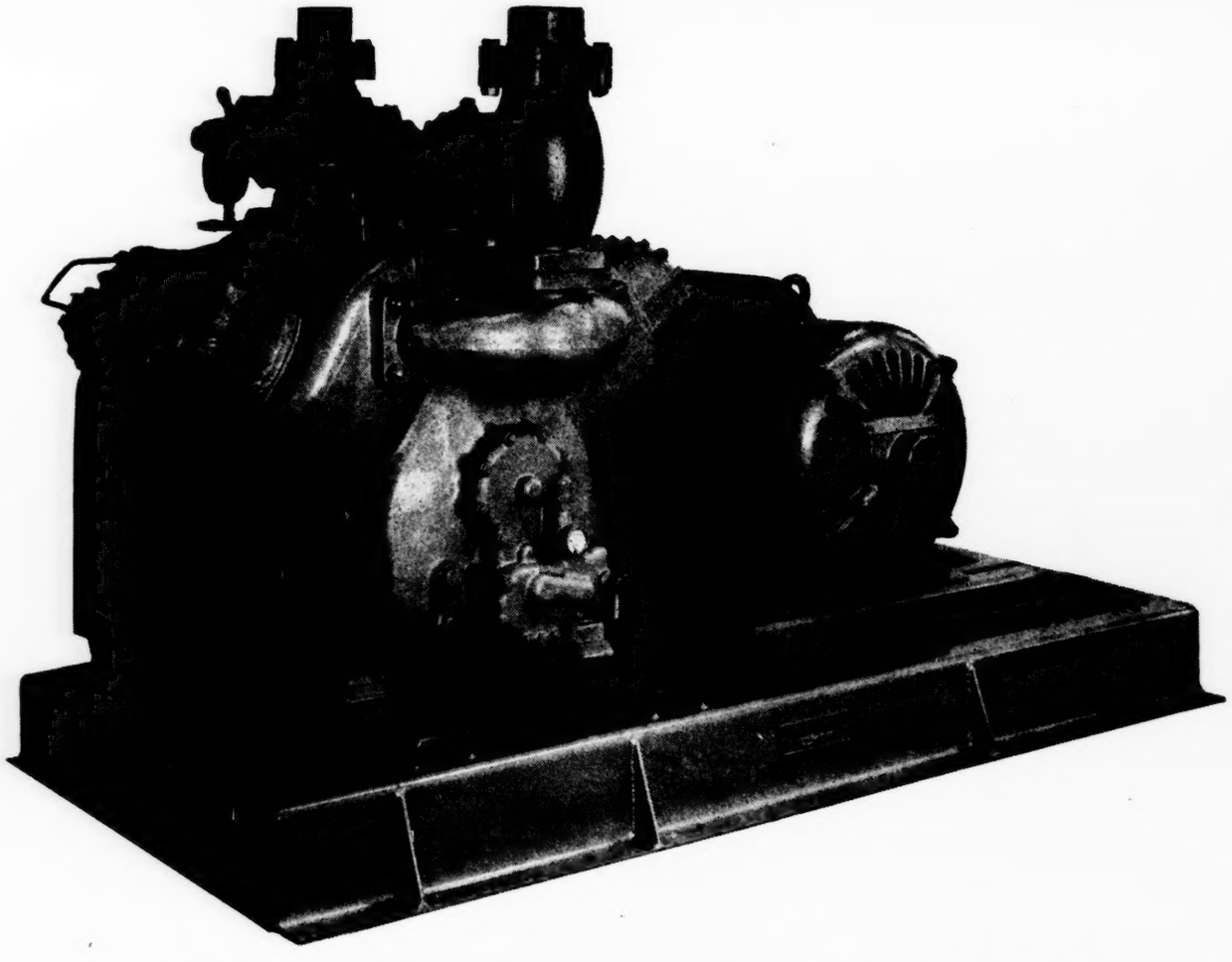
US Gauges

RUSH ON FOR COPIES of BIGGEST GAUGE CATALOG

The demand for copies of this new U. S. Gauge catalog exceeds all estimates. 102 Pages. Gauges and gauge movements, gauge manufacture. Logically arranged and cross-referenced. Special easy-to-use features for saving your reading time. Just send a request on your business letterhead for your copy—no obligation.



UNITED STATES GAUGE
DIVISION OF AMERICAN MACHINE AND METALS, INC.
SELLERSVILLE, PA.
Manufacturers of Pressure, Temperature, Flow, and Electrical Measuring Instruments



A NEW LINE OF "EASY BREATHING" COMPRESSORS

for low pressure refrigerants

These new compressors do more work at less cost because Worthington has designed them to "take it easy."

Construction is simplified . . . light weight has been achieved at no sacrifice of durability . . . and famous Worthington Feather* Valves — simplest, lightest, most reliable ever designed for compressor work — eliminate shock, wear and noise.

Maintenance is easy, too. Moving parts are easily accessible. Bearings are renewable. And in larger sizes cylinder liners and forced feed lubrication contribute to trouble-free service.

One basic design, that stems from Worthington's more-than-a-century-old experience, covers a size range from 2 to 125 HP; with three cylinder sizes. Positive partial-capacity control is provided.

WORTHINGTON MEANS "INTEGRATED" SYSTEMS

Around this new compressor are designed Worthington condensing units — water-cooled or arranged for evaporative condenser operation. Units are compact and economical to install and operate . . . include Worthington Multi-V-Drive, specially-designed high-starting-torque, low-starting-current motor, high and low pressure safety controls.

In fact, Worthington makes so many of the "vitals" of an air conditioning system that it is your best source for an "integrated" system — efficient and economical.

Before specifying, engineering, or installing air conditioning and refrigeration equipment, find out why so many architects, contractors, building operators, have learned that *there's more worth in Worthington.*

Write *Worthington Pump and Machinery Corporation, Harrison, N. J. Specialists in air conditioning and refrigeration machinery for more than 50 years.*

*Reg. U. S. Pat. Off.

WORTHINGTON

A5-28

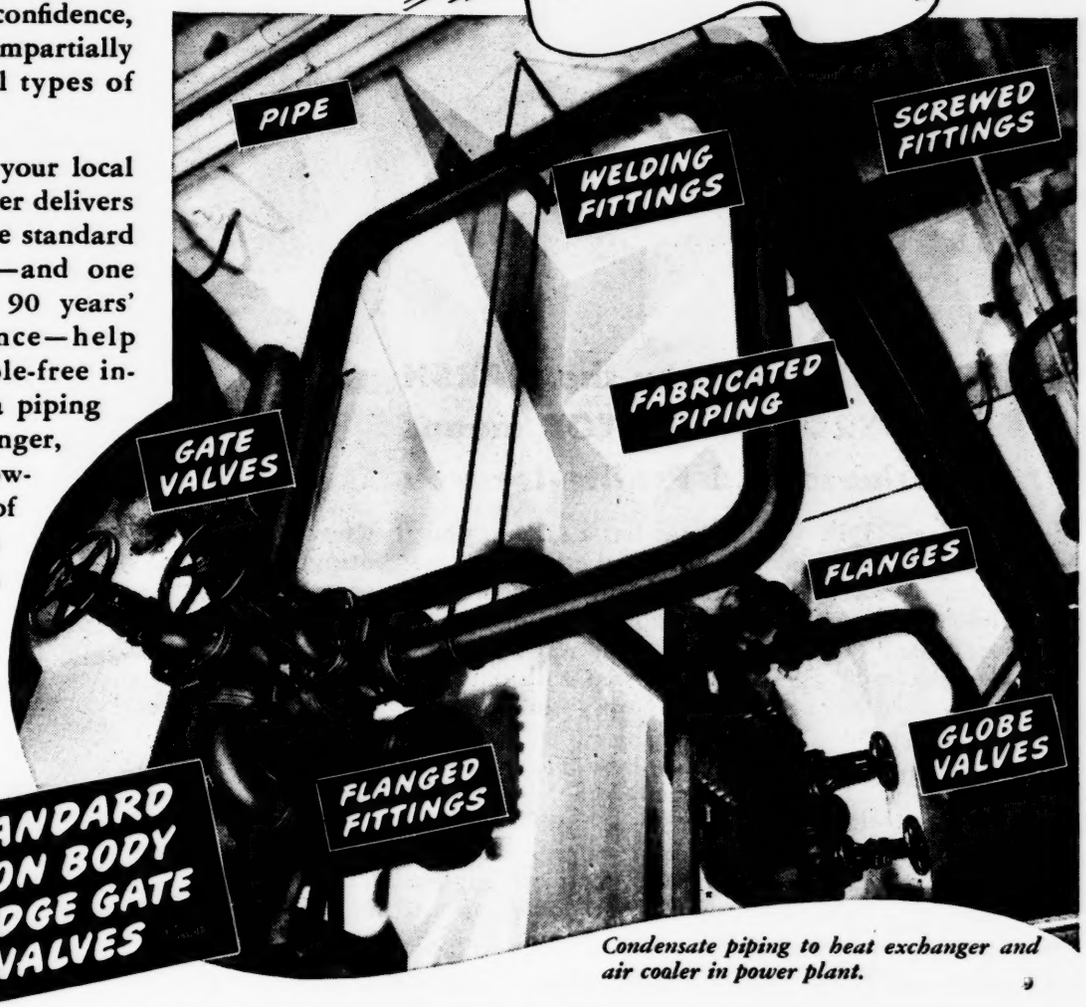
Air Conditioning

Piping Conversion *Simplified*...
CRANE Supplies Everything

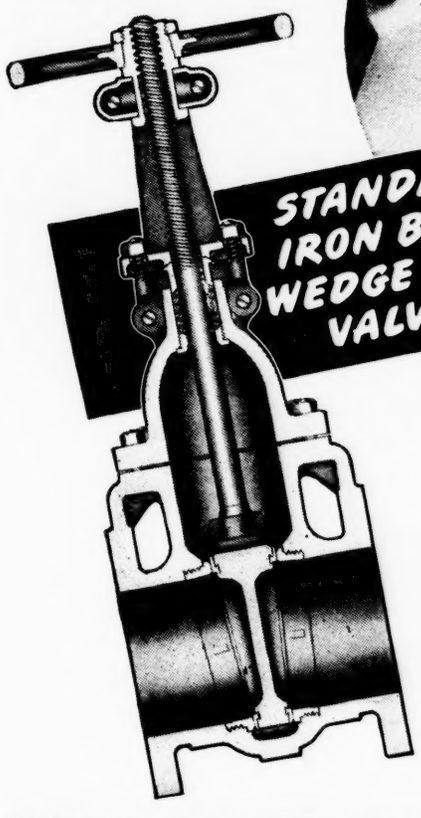
ONE SOURCE OF SUPPLY
ONE RESPONSIBILITY
ONE STANDARD OF QUALITY

• Whether piping reconversion jobs are big or small, Crane is your logical partner to help get them done quickly. You select *all* materials from the world's largest line of valves, fittings, pipe, accessories and fabricated piping. You specify with complete confidence, for Crane can point out impartially the relative merits of all types of piping equipment.

Ordering is simplified—your local Crane Branch or Wholesaler delivers everything to the job. One standard of quality in every item—and one responsibility backed by 90 years' manufacturing experience—help assure time-saving, trouble-free installations. The result is a piping system that will operate longer, at highest efficiency and lowest cost. For one example of *complete* Crane lines in brass, iron, and steel valves, see below.



Condensate piping to heat exchanger and air cooler in power plant.



STANDARD IRON BODY WEDGE GATE VALVES

SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** are suited for many services in factories and power plants, at all working pressures up to 125 pounds steam. Brass trimmed valves are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S. & Y. and Non-Rising Stem patterns. See page 101 of your Crane Catalog.

WORKING PRESSURES

Size of Valve	Screwed or Flanged End Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-in., Crane 150-Pound Cast Steel Gate Valves are recommended. (For sizes under 2-in., use Crane Clamp Gate Valves.)

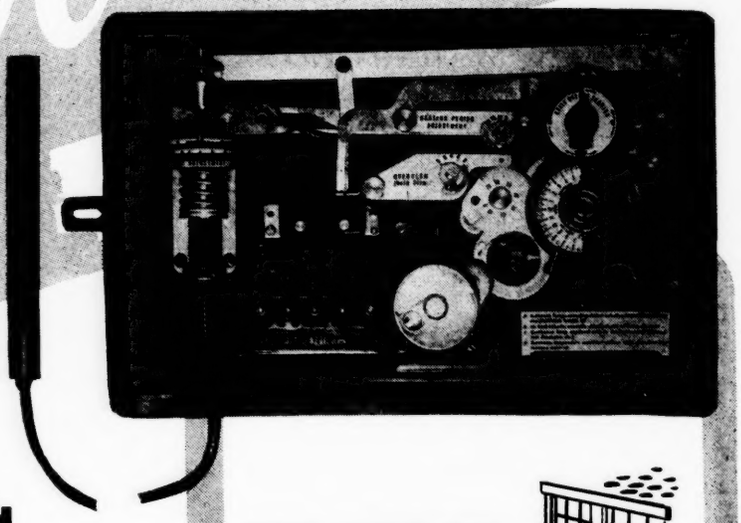
CRANE CO., General Offices: 836 S. Michigan Ave., Chicago 5, Ill. • *Branches and Wholesalers Serving All Industrial Areas*

CRANE

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

Control

is the first and last word in fuel saving



. . . . That's why the MARSH TRI-TROL REGULATOR means Business and Profits for you

The Marsh Tri-trol Regulator has a sales appeal that few products have ever had. It hits at the heart of the heating problem. It solves the problem most difficult to solve in apartments, hotels, office and factory buildings—the problem of heat control. It solves it in the only way it can be solved—by keeping inside temperature in step with outside weather. It has a proved record of fuel economy—savings up to 30%—in hundreds of buildings.

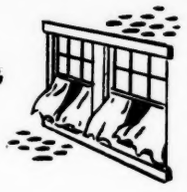
When you tell your customer how Tri-trol regulates the heating of his building from the outside temperature, he sits up and takes notice. You can show him how it gives even, modulated heat by automatically varying heating periods according to outside temperature. You can explain how it automatically gives the proper length of warm-up time in the morning and correct shut-down time at night as guided by the weather.

When it comes to price, you can give him the glad news that it costs little more than an inside thermostat complete with all accessories, for the accessories—a 65° cut-off switch, day-night time switch, hold-fire, and relay—are all built into the Tri-trol.

Every function of the Tri-trol—length of heating cycles and length of warm-up and shut-down periods—is readily adjustable to the requirements of the individual building. Once adjusted the periods are automatically maintained. There is a big market for Tri-trol right now in older buildings and you can make it the spearhead for stoker and oil burner sales. Write or wire for facts.

MARSH HEATING EQUIPMENT COMPANY
2122 Southport Avenue, Chicago 14, Illinois

STOPS OVERHEATING



CUTS FUEL COSTS

PROVIDES EVEN HEAT

A broader postwar service for heating men

Marsh Heating Equipment Company is the new name of Marsh Tritrol Company. The activities of the company have been broadened to include the distribution of the heating specialties of Jas. P. Marsh Corporation, and the new name was adopted to more accurately describe the broader operations. Marsh products include steam traps of all types, air venting devices, radiator air valves, packless radiator inlet valves and other specialties. Let us work with you in solving your heating problems.

MARSH *Quality Heating Specialties* SINCE 1865

Meet Demon Heat

Heat's a stealthy thief—always sneaking in to rob business of profits in countless ways.

Marlo Fin Coils outwit Demon Heat through efficient heat transfer. Our engineers have a quarter-century's priceless experience at your disposal.

MARLO = HEAT TRANSFER

MARLO

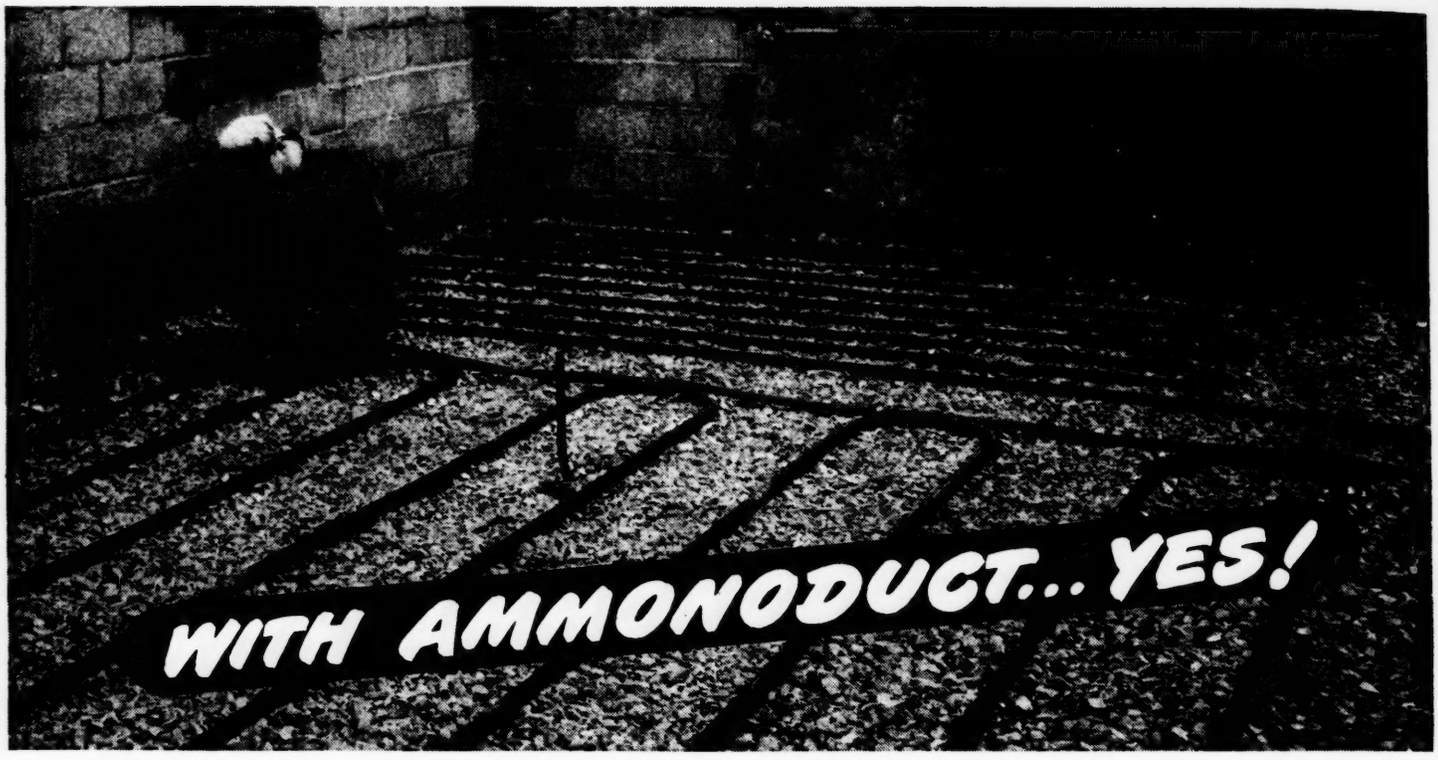
HEAT TRANSFER SURFACE

Ball-Bonded Blast Coils—Cooling and Heating • Air Conditioning and Refrigeration Apparatus • Industrial Blower Units • Unit Coolers • Evaporative Condensers and Coolers • Low Temperature Apparatus.

MARLO COIL COMPANY

ST. LOUIS 10, MISSOURI

COULD YOU COLD-BEND A JOB LIKE THIS WITH CONFIDENCE?



Ammonoduct is the pipe for radiant heating because it's *so ductile you can bend it cold* without the need for pipe filler. There's no danger of fracturing the metal wall. Cold bends can be made at the job just as easily as in your shop. No annealing needed, of course.

Ammonoduct welds readily, too. No special welding technique is required. Even welders with slight experience have little difficulty in making tight, sound welds, free of pinhole leaks.

Further, Ammonoduct is more than a match for the corrosion encountered in any radiant heating system. There's no need for expansion worries, either, for Ammonoduct's coefficient of expansion is practically identical with that of the concrete or plaster used in floors and ceilings.

Manufactured from a special low-carbon open-hearth steel by the continuous-weld process, Ammonoduct is regularly furnished in sizes from ½ in. to 3 in., standard-weight and extra-strong, and in uniform 21 ft. lengths, plus or minus 1 in.

Is Ammonoduct expensive? Not at all! With all its advantages, it sells for the same price as regular steel pipe. Order it from your Bethlehem distributor whenever you have a radiant heating job.

Cold-bending Ammonoduct used throughout this installation

Above is part of the radiant-heating installation in an office building for Hudson Coal Co. at Olyphant, Pa. The system was designed by A. Ernest D'Ambly, Consulting Engineers, Philadelphia. Pipe coils for the ground floor were installed on a stone fill, and buried in a 5-in. concrete slab. Floor coils for the second-story were laid on expanded metal lath over Bethlehem joists, then covered with 4 in. of concrete. There were no ceiling coils. Ammonoduct Pipe (1 in.) was used throughout. All bends were made cold.

AMMONODUCT

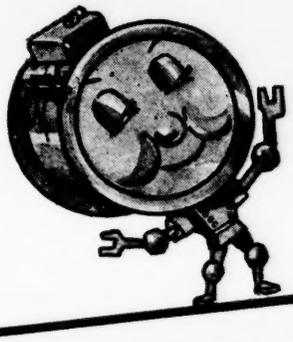
EASY WORKING . . . BENDS COLD

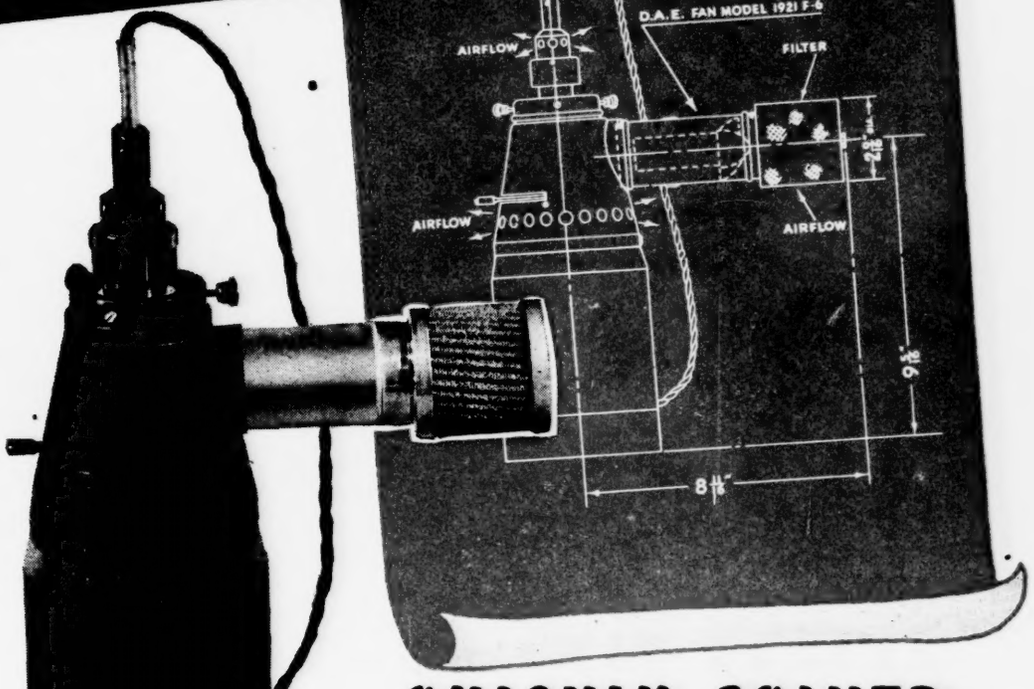
★ BETHLEHEM STEEL ★

ADAPTATION IS A PUSHOVER!

PROBLEM

To cool the portable projector to a maximum temperature rise of 35°F on the case surface, and to filter inlet air, eliminating dust from the air stream to keep multiple lenses clean. Current available: 20-23 V., D.C.





QUICKLY SOLVED

***Dynamic Air Axial Flow Blower* No. 1921F-6 (2" diameter), with an aluminum mesh filter, delivers 10 C.F.M., net, through the projector . . . and holds temperature rise to 15°F. Total weight of fan and filter, 10 oz.**

Once the facts of the problem were known, adaptation of a Dynamic Air Axial Flow Blower and a Dynamic-designed heating unit to deliver the correct air flow at the required temperature rise was a "pushover" for Dynamic's experienced air engineers! This problem is typical of help they are giving in many fields—for both war and postwar needs.

Pioneered by 14 years' laboratory and field development work, Dynamic's Axial Flow Blowers are the most advanced application of the "air delivered in a straight line" principle . . . with a big saving in space, weight and horsepower input.

If you have an air movement problem in connection with present or projected equipment, take advantage of Dynamic's long experience in solving difficult blower problems . . . *write or wire today!*

DYNAMIC AIR AXIAL FLOW BLOWERS—ENGINEERED TO SAVE SPACE, WEIGHT AND HORSEPOWER — ARE BEING USED FOR:

Electronic tube cooling
Airplane heating
Warm air furnaces
Oil burners
Stokers
Refrigeration locker plants
Quick freeze units
Trains and buses
. . . and for many other types of equipment requiring blowers.

GENERAL SPECIFICATIONS

24/28-V D.C.	1/500 to 4 h.p.
115-V D.C.	1/100 to 4 h.p.
115-V A.C.	1/100 to ½ h.p.
400-cycle A.C.	1/500 to 1 h.p.

Prototypes Available

DYNAMIC AIR ENGINEERING Inc.
LOS ANGELES, U. S. A.
DESIGNERS and BUILDERS of HIGH EFFICIENCY AXIAL FLOW EQUIPMENT

How SKILSAW Protects Equipment *"in-the-Package"*

Moisture "in-the-package" causes vast damage to precision equipment.

Skilsaw, Inc. prevents this damage by means of Jay Cee Silica Gel, the ideal drying agent. A few small bags of the Jay Cee Gel are included within tightly sealed packages of electric handsaws, drills, and other tools. The gel has amazing power to adsorb and hold moisture. Thus the air in the package is kept thoroughly dry and damage from rust or corrosion is avoided.

This practice is being followed by more and more manufacturers of metal products. The cost of the gel is a mere trifle in comparison with the possible damage from rust or corrosion.

Jay Cee Silica Gel has wide application in the Air Conditioning, Refrigeration, and Chemical industries. It is clear white; passes a rigid section test; meets exacting Government specifications; is strictly a quality product.

A few excellent Jay Cee Silica Gel sales territories are still open to jobbers. Write for details.

JOLIET CHEMICALS, LTD., INDUSTRY AVENUE, JOLIET, ILLINOIS

JAY EE

SILICA GEL

A superior dehydrant

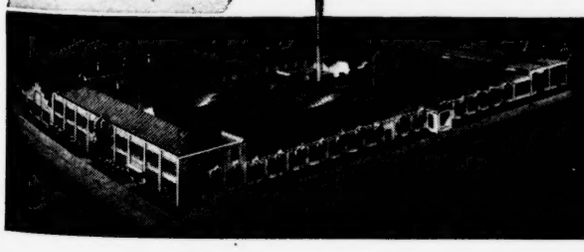
NIBCO **WROT**
Copper Fittings

The SOLDER JOINT in Copper Plumbing

A WELL-MADE solder joint is stronger than the tube it joins! Examine a cut-away section of a NIBCO Fitting joined to a copper tube under the microscope and you'll see why. A perfectly uniform, dense fillet of tin joins copper to copper permanently . . . without danger of leakage. The inside of the joint is smoother, too, with no flow restriction.

Any good mechanic can quickly learn the knack of making perfect solder joints with NIBCO Fittings because they're so accurately formed and the necessary close tolerances are maintained with absolute precision. We'd like to send you a folder outlining the six simple steps of making a solder joint. There's no obligation.

Ask for Catalog "E" and Leaflet "The Fine Art of the Solder Joint"



NORTHERN INDIANA BRASS CO.
ELKHART, INDIANA
VALVES AND FITTINGS SINCE 1904

Let a *Moisture Engineer* tell you all about the Kathabar System in air conditioning

Let a Moisture Engineer explain how the Kathabar System automatically and accurately controls humidity, independently of temperature, to provide the ultimate either in comfort or in industrial processing applications—why it eliminates Chill, Shock and Clamminess in atmospheres where personal comfort must be at its best—why it eliminates the excessive cost of Over-cooling and Reheating, or Overheating and Recooling to give selective atmospheric conditions best suited to individual processing operations. One Kathabar user has said: "It has given us a new concept of air conditioning."

The *full* importance of "functional air conditioning" and humidity as a vital factor in maintaining desired results is immediately evident from the new MOISTURE ENGINEERING and Kathabar Application Chart.

This new chart, based upon psychrometric principles, clearly illustrates and defines the two functions of air conditioning, i.e. the control of both *temperature and humidity*. It is becoming a practical and understandable tool in determining the function and the type of equipment necessary to provide a condition best suited to specific air-conditioning jobs.

If you are planning a new air-conditioning installation, let a MOISTURE ENGINEER analyze the problem with you. REMEMBER, there is more than one method of approaching personal comfort or industrial air-conditioning problems.

Have you seen the new bi-monthly bulletin "The Moisture Engineer," which is devoted to moisture-humidity problems in air conditioning and to Kathabar Systems and their application? Circulation will be limited. However, additional names can still be added to territory lists, at the present time. If you would like to receive it, write to—

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AUTOMATICALLY CONTROLLING HUMIDITY FOR COMFORT AND INDUSTRIAL PROCESSING

Kathabar System of
HUMIDITY CONTROL
(ADVANCED AIR CONDITIONING)

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Help Give You Greater Efficiencies at Lower Cost

Today AMP Corporation is manufacturing millions of highly specialized units for the Army and Navy, many of which were originated by AMP engineers. Tomorrow, all of our extensive manufacturing and research facilities will be at the service of industry.

AMP specialized controls and refrigeration systems and accessories embody new, patented principles that offer manufacturers and processors better performance, higher efficiency, and lower cost.

In these three basic fields, AMP technological advances and superior engineering provide much of interest to any manufacturer or user of refrigeration equipment:

1. Refrigeration, air conditioning, and processing flow controls
2. Refrigeration specialties
3. Beverage carbonator-refrigerating units and dispensers

In refrigeration, AMP devices assure higher utilization of thermal energy, greater operating economies. In the beverage dispensing field, AMP automatic carbonation and refrigeration has been acclaimed by experts to be the finest ever produced.

Let AMP Corporation cooperate with your engineers to show you how AMP controls and specialties may well help solve many of your individual problems wherever refrigeration systems or controls are involved.

CORPORATION

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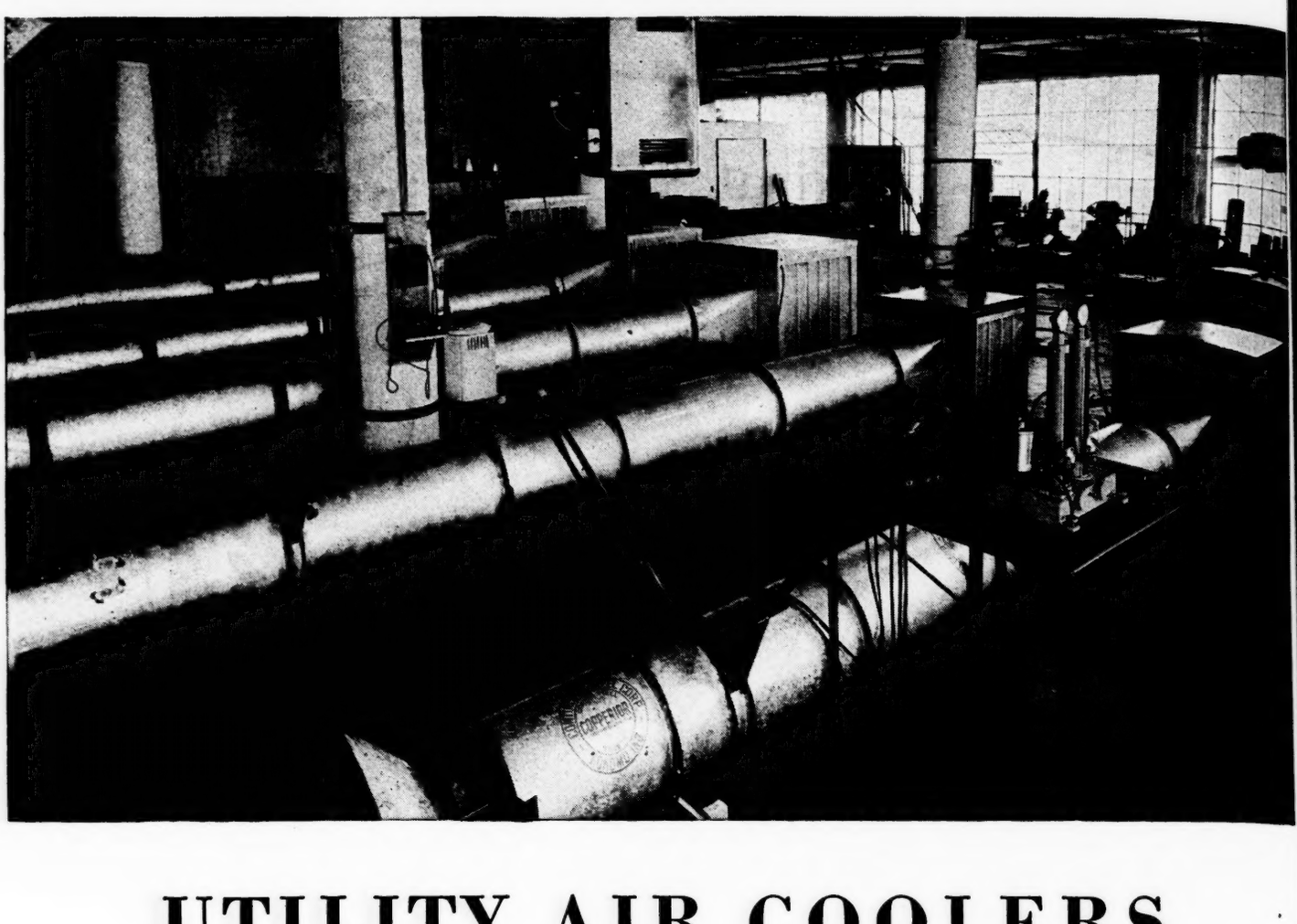

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are scientifically tested in our modern laboratory

Utility Air Coolers, Fans and Blowers are tested for accuracy and efficiency in this most modern and complete laboratory, in accordance with American Society of Heating and Ventilating Engineers' standard test code.

These extensive testing and fact finding facilities, under the supervision of competent and recognized engineers, are your assurance of properly engineered and efficient products, coming from Utility Appliance Corp.

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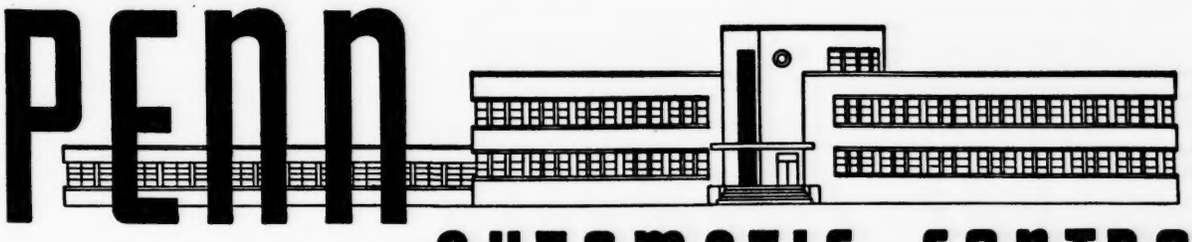
FORCED AIR FURNACES
Manufacturers of Evaporative Air Coolers, Blowers, Fans, Forced Air Furnaces, Circulating Heaters, Unit Heaters and Floor Furnaces.
EVAPORATIVE AIR COOLERS
SPACE HEATERS
FLOOR FURNACES

• There's an easy, low-cost way to save fuel in factories this winter. Simply equip unit heaters with PENN thermostats . . . featuring the *built-in "on-off" switch.* Then, *to cut down fuel waste,* merely rotate the dial to the "off" position which stops heat flow during idle periods—to little-used areas—or to areas where heat can escape, such as a shipping room or receiving room which may be exposed for considerable periods to outside temperatures.

In summer this "on-off" feature can prove equally convenient. By rotating the dial to "on" position, the unit blower fan will operate continuously, supplying summer ventilation.

Plant owners will appreciate this easy way to obtain fuel economy in winter . . . comfortable and healthful ventilation in summer. Be sure to get full information on PENN Unit Heater Thermostats . . . or practical assistance on any heat control problem. Write *Penn Electric Switch Co., Goshen, Ind.* Export Division: 13 E. 40th Street, New York 16, U. S. A. In Canada: Powerlite Devices, Ltd., Toronto, Ont.



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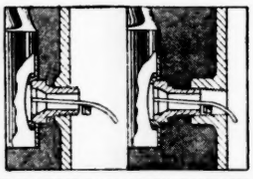
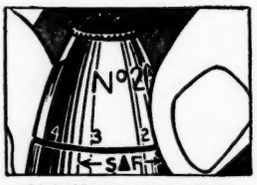
FOR HEATING, REFRIGERATION, AIR CONDITIONING, ENGINES, PUMPS AND AIR COMPRESSORS



NEW, IMPROVED HINGED TONGUE
Diagrams above show how Hoffman Hinged Drainage Tongue construction adapts itself to radiators equipped with various boss lengths. It is a major improvement, assuring good drainage under all conditions of service. An exclusive Hoffman feature.

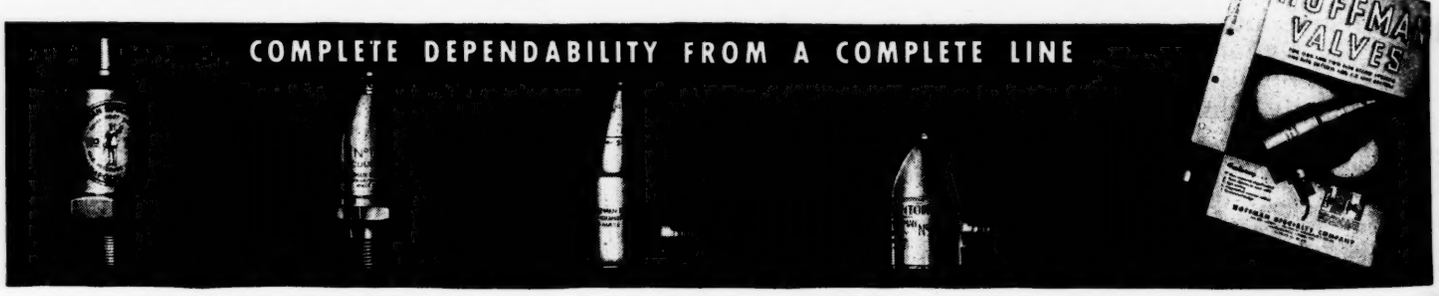


ADJUSTABLE VENT PORT
Comparative tests show the Hoffman vent port adjustment to provide a smoothly graduated rate of venting in direct proportion to the size of the opening. Adjustable to prevent waterlogging, spitting and rumbling caused by too fast venting.

Your prospects for an immediate big sale of vent valves have never been brighter! Fuel must be conserved . . . and in steam heating systems, proper venting is the first step. Hoffman Valves are ready for the job with a full line of units for venting mains and radiators.

In spite of war conditions which have affected the design and quality of many products, Hoffman Vent Valves still offer the superior operating features which have made them the standard of performance for so many years. Double Air Locks —Short-Tongue Siphons—and Six Speed Venting are a few of the reasons why Hoffman Valves help to get full value from fuel burned.

Wholesalers now have full stocks—you can start any time to cash in on the genuine need for steam system renovation. For complete information on Hoffman Main and Radiator Vent Valves, send for new illustrated catalog.



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